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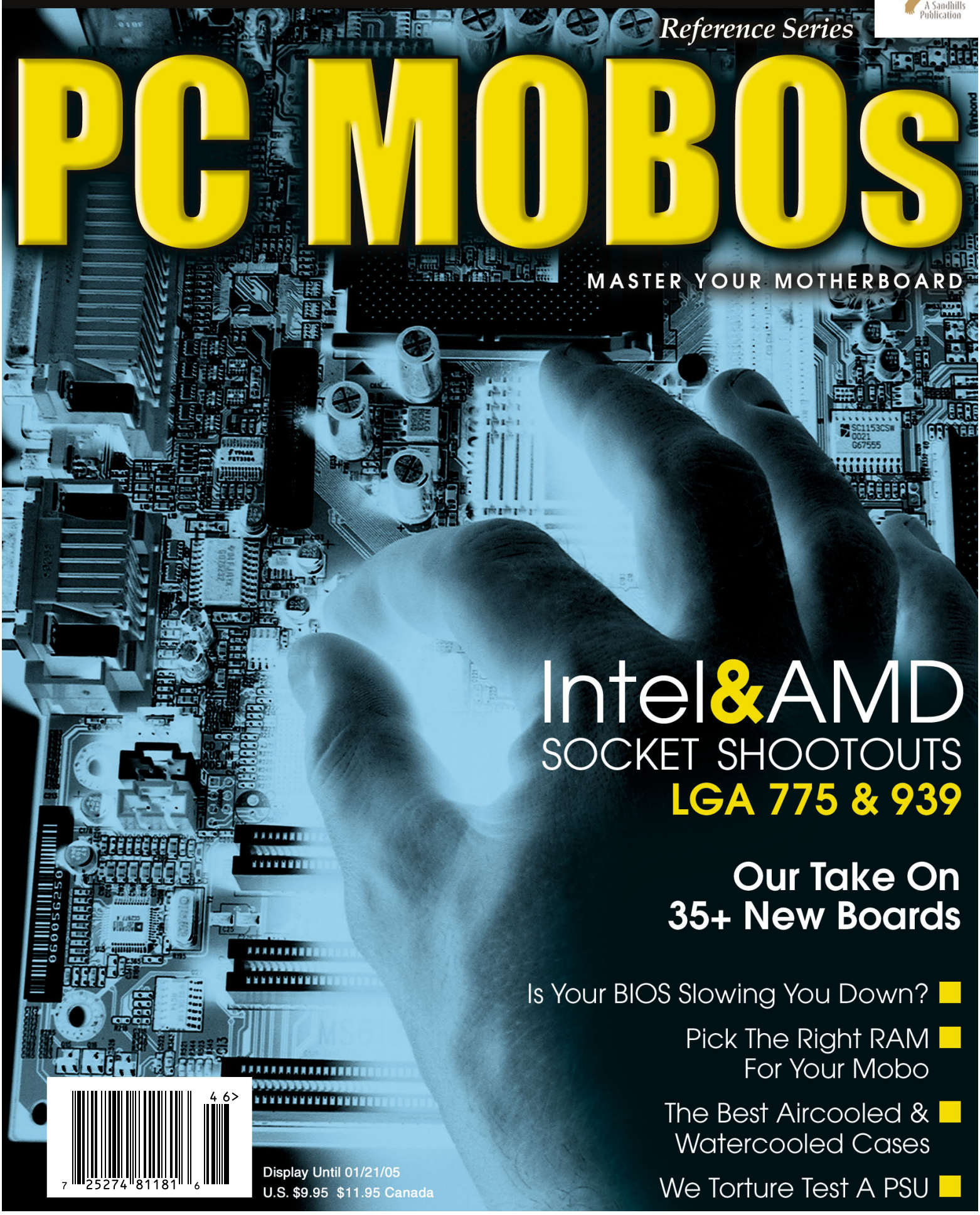

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TABLE OF CONTENTS

CPU Special Issue v.1.0

If you've been fitfully scrounging the newsstand looking for scraps of motherboard info, you might want to have a seat before you turn the page. Feature articles; standalone reviews of PSUs, cases, and (of course) dozens of mobos; roundups of the latest LGA 775 and socket 939 boards; technology white papers; bucketloads of benchmarks . . . we packed so much mobo info in this issue that even the most insatiable hotshot board jockeys can get their fill. We know, as you do, that the mobo is the main course at the PC table. Now dig in and enjoy.

Mobo News

4 **Mobo News**
The Latest In All Things Mobo

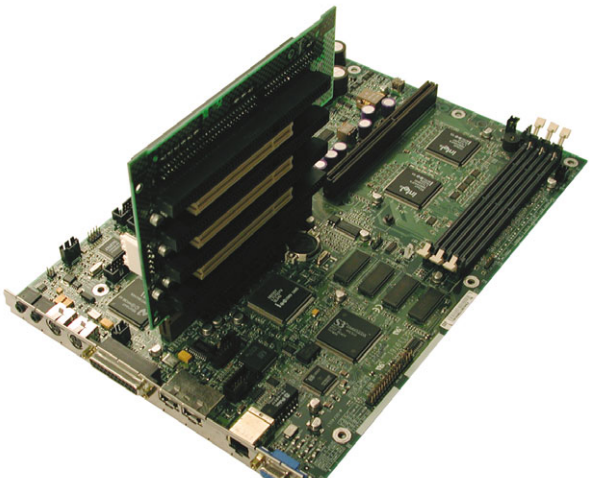
Board Basics

10 **Mobo Configurations**
Various Form Factors Have Shaped The History Of The Motherboard

18 **Sockets, Buses, Slots & Ports**
What Goes Where On Most Mobos

24 **Tech White Paper: Hopping On The HyperTransport Bus**
An Inside Look At The Backbone Of AMD64

27 **Tech White Paper: PCI Technologies**
Aging Bus Technology Still Has Plenty Of Life Yet



Mobo Reviews

30 **Mobo Mania**
All The Info You Need To Pick Your Next Board

Socket 478

31 **Abit VT7**
34 **Soyo SY-P4VTP**
37 **ASUS P4S800D-E**
40 **GIGABYTE GA-8IG1000 Pro-G**
43 **ASUS P4R800-V Deluxe**
46 **Chaintech S865PE**
49 **Chaintech 9CJS Zenith**
52 **GIGABYTE GA-8I915G Pro**

LGA 775

55 **MSI 915G Combo-FR**
58 **Intel D915PCYL**
61 **ASUS P5GD2 Deluxe**

Socket A

64 **ABIT NF7-S (Version 2.0)**
67 **ASUS A7V880**
70 **DFI NFII Ultra Infinity**
73 **SOYO SY-KT600 Dragon Ultra Platinum**

Socket 754

76 **ECS 755-A2**
79 **AOpen AK89 Max**
82 **GIGABYTE GA-K8VNXP**
85 **EPoX 8KDA3+**
88 **MSI K8T Neo-FIS2R**
91 **Soltek SL-K8AN2E-GR**

Socket 940

94 **ASUS SK8N**
97 **ASUS SK8V**
100 **GIGABYTE GA-K8NNXP-940**
103 **MSI K8T Master2-FAR**

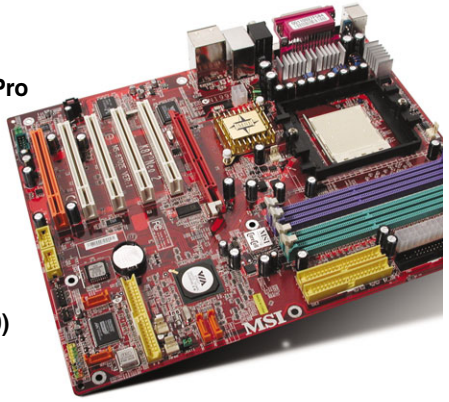
Socket 939

106 **GIGABYTE GA-K8NSNXP-939**
109 **MSI K8N Neo2 Platinum Edition**

Socket 940 (Dual)

112 **Tyan Tiger K8W S2875**
115 **MSI K8T Master2-FAR**

118 **Intel Mobo Bench Summary**
Compare A Few Key Stats From Our Intel-Compatible Reviews

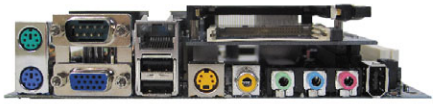


119 **AMD Mobo Bench Summary**
Compare A Few Key Stats From Our AMD-Compatible Reviews

Board Battles

121 **AMD Mobo Leader**
We Throw Five Socket 939 K8T800 Pro Mobos At The Wall To See Which One Sticks

127 **Intel High-End Shootout**
Six 925X Boards Go Head-To-Head



133 **Mighty Mites**
Attack Of The Mini-ITX Motherboards

BIOS

138 **Bundles Of BIOS Update Utilities**
We Update Five Motherboards In A Flash

142 **The BIOS Factor**
Gauging A BIOS Update's Impact

144 **The Big List**
Is Your BIOS Behind The Times?

148 **Tech White Paper: The Boot Process**
A Peek Behind the Curtain

Storage

Hard Drive Reviews

151 **Maxtor MaxLine II QuickView EIDE 300GB**
Western Digital Caviar Special Edition EIDE 120GB
152 **Hitachi GST Deskstar 7K250 EIDE 164.7GB**
Seagate Barracuda 7200.7 EIDE 160GB
153 **Samsung SpinPoint SP1614N EIDE 160GB**
Maxtor DiamondMax Plus 9 EIDE 200GB
154 **Hitachi GST Travelstar 5K100 EIDE 80GB**
Hitachi GST Deskstar 7K400 SATA 400GB
155 **Western Digital WD2500SD RAID Edition SATA 250GB**
Maxtor DiamondMax 10 SATA 250GB
156 **Seagate Barracuda 7200.7 SATA 160GB**
Western Digital Raptor SATA 74.3GB
157 **Hitachi GST Deskstar 7K250 SATA 82.3GB**
Samsung SpinPoint SP0812C SATA 80GB

158 **Seagate Savvio Ultra320 SCSI 73.4GB**
Maxtor Atlas 15K Ultra320 SCSI 73GB
159 **Hitachi GST Ultrastar 15K73 Ultra320 SCSI 73.9GB**
Seagate Cheetah 15K.3 Ultra320 SCSI 18.4GB
160 **Tech White Paper: Intel Matrix RAID**
RAIDs 0 And 1 Together On Just Two SATA Drives

CD/DVD Drive Reviews

163 **Sony DRU-710A**
BenQ DW1620
164 **NEC ND-3500A**
Pioneer DVR-108BK
165 **Plextor PX-712SA**
Sony DRU-700A
166 **Optorite CW5201 52X/32X/52X CD-RW**
Plextor Premium 52X/32X/52X
167 **Samsung SM-352B 52X/32X/52X CD-RW 16X DVD-ROM**
Lite-On SOHC-5232K 52X/32X/52X CD-RW 16X DVD-ROM
168 **Optimize Optical Drives**
Firmware Updates & Other Tweaks
171 **Tech White Paper: DVD Standards**
Unraveling The Differences

PSUs & Cases

PSU Reviews

174 **Aerocool AeroPower Black/Silver Line 550W**
Antec NeoPower 480
175 **Antec Phantom 350**
Aspire Concord ATX-MR500W
176 **Cooler Master Real Power 450W**
Fortron Source AX500-A
177 **SilverStone SST-ST30NF**
ThermalTake Silent PurePower TWV480
178 **Ultra X-Connect 500W ATX**
Vantec ION 2 350W
179 **The Big Overload**
Find Out Just How Far You Can Push A Power Supply

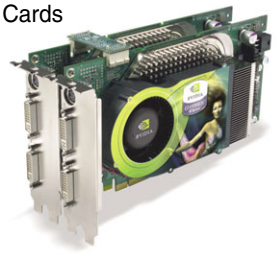
Case Reviews

182 **Thermaltake Xaser III Super Tower V1420DU**
183 **Raidmax Scorpio 668W**
184 **Cooler Master Centurion 5**
185 **A-Top Technology Z-Alien**
186 **Aspire X-Dreamer II**

187 **Lian-Li PC-3077A**
188 **Antec Performance Plus1080AMG**
189 **Chenming 601 Aluminum Silver**
190 **ENERMAX CS-5190AL**
191 **SilverStone Temjin TJ04**
192 **Koolance PC2-601BW**
193 **Custom Chenming 901 Watercooled Case**
194 **DangerDen Watercooled Verge**
195 **Cooltechnica AquaXtreme XG**
196 **A Case Of A Serious Income Gap**
An Enclosure For Scrooge & One For Donald

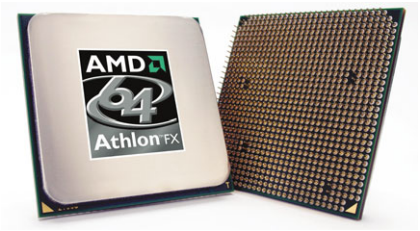
Video & RAM

198 **Integrated vs. AGP**
Our Tests Compare Built-In Video With Third-Party Cards
202 **The Great GPU Wars**
Graphics Giants Square Off Again
204 **No Need To RAM Your Head Against A Wall**
Choose The Right Memory For Your System
206 **Tech White Paper: NVIDIA's SLI Technology**
Two Video Cards Are Better Than One



Mobo Mojo

208 **Our Top Tips For Motherboards**
The Three Bs: Buying, Building & Bug-Hunting
212 **Mighty Motherboard Toolbox**
A Quick Roundup Of Geek-Friendly Mobo Widgets
217 **Mobo Q&A**
Delve Deeper Into The Motherboard Market



Manufacturer & Product Index

223 **Alphabetical Listing Of Manufacturers & Products In This Issue**

Mystery Mobo

224 **Whose Board Is It, Anyway?**
Our Biggest Fan

Editorial Staff: Ronald D. Kobler / Samit Gupta Choudhuri / Corey Russman / Rod Scher / Christopher Trumble / Calvin Clinchard / Kimberly Fitzke / Katie Dolan / Blaine Flamig / Raejean Brooks / Rebecca Christensen / Tara Weber / Sally Curran / Michael Sweet / Katie Crooks / Shawn Kupfer / Dana Montey / Nate Hoppe / Sheila Allen / Jennifer Hansen / Trista Kunce / Linne Ourada / Marty Sems / Chad Denton / Nathan Chandler / Kylee Dickey / Josh Gulick / Andrew Leibman / Vince Cogley / Sam Evans
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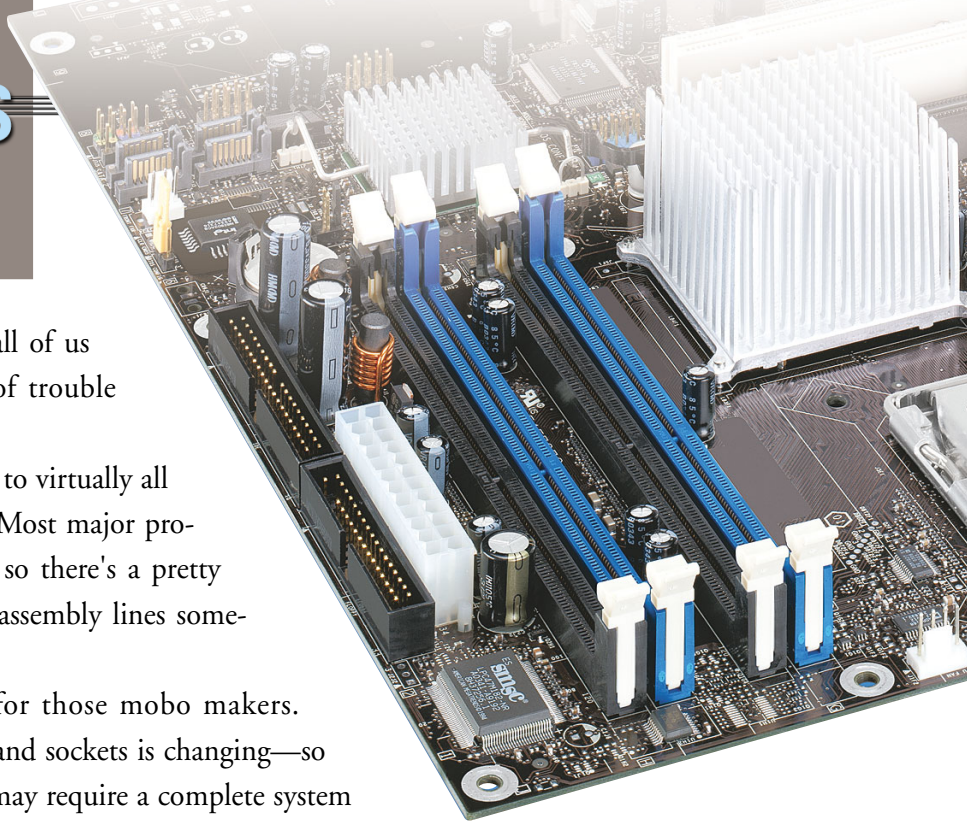
MOBO NEWS

THE LATEST IN ALL THINGS MOBO



If it weren't for Taiwan and China, all of us computer users would be in a lot of trouble right about now.

Why those two countries? They're home to virtually all of the major motherboard manufacturers. Most major production facilities are in Taiwan or China, so there's a pretty good chance your mobo rolled off of the assembly lines somewhere in one of them.

And right now, it's an exciting time for those mobo makers. Everything from GPUs to RAM to CPUs and sockets is changing—so much that upgrading a single component may require a complete system overhaul. We'll take a look at some of the new features today's hottest mobos are offering, and some of the leading manufacturers will weigh in on how their companies are tackling these features and preparing for the road ahead.

Supply & Demand

Any growth in the PC market is good news for motherboard manufacturers. Research firm IDC recently released its Worldwide Quarterly PC Tracker, which charts PC sales growth and issue forecasts for future PC sales. Based on strong second quarter sales, IDC expects the number of PCs shipped worldwide for both consumer and commercial markets combined to reach 176.5 million by the end of the year. This number is up from 154.6 million PCs shipped last year, a 14% increase.

In 2001, total worldwide PC sales totaled 135.6 million. That number crawled upward to 138.2 million before jumping to 154.6 million in 2003. IDC said it expects PC sales in 2005 to reach 195 million, closing in on the 200 million mark.

Loren Loverde, IDC's Worldwide Quarterly PC Tracker director, warned against an overly optimistic reaction. "The market needs to be careful in interpreting these results. Strong growth in Western Europe and [the] rest of the world played a significant role in boosting second quarter results," she said in a recent press release from IDC.

IDC said the high growth in recent quarters is, in part, a result of a depressed market in past years. It expected growth would slow as the market recovers.

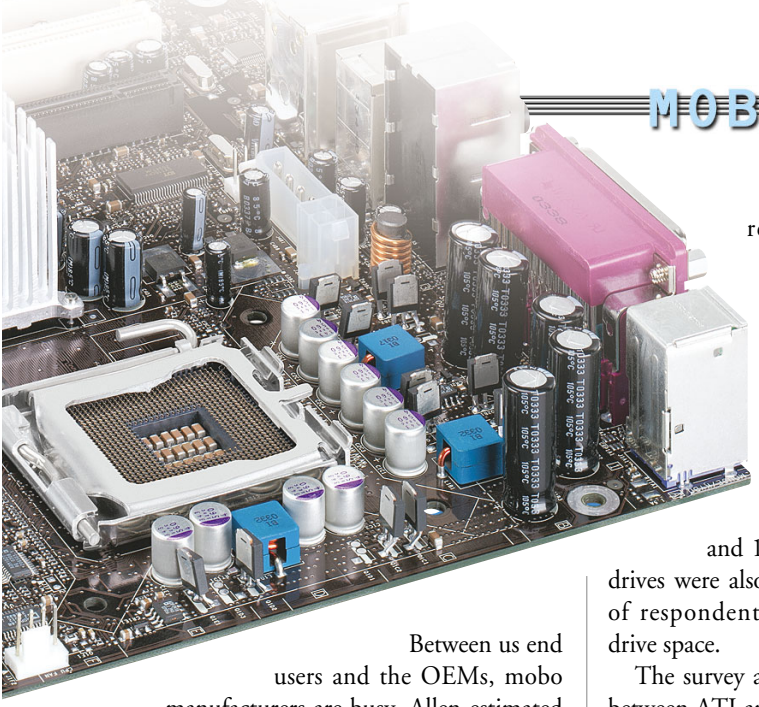
Regionally, commercial demand should remain strong in the United States as consumer demand tapers off. Growth in Western Europe should remain strong, while growth in Japan should continue to be slow. Globally, the number of PCs sold to commercial users looks to continue to be about double the number shipped to consumers. See the inset for more information.

According to Rick Allen, marketing manager at ASUS, mobos are doing as well as PCs. Last year, ASUS reported revenues of $6 billion. This year, it expects to hit $9 billion. Motherboards constitute 31% of the company's business, and ASUS has shipped a bundle of them: 17 million mobos in 2002, 29 million in 2003, and it's aiming to ship 50 million in 2004.

"We guesstimate that at least one in four motherboards shipping now is made by ASUS," Allen said.

Region	2001	2002	2003	2004*	2005*
USA Units (M)					
Consumer	15.5	17.1	20.0	21.6	22.8
Commercial	30.5	30.5	32.7	36.4	40.7
Total	46.1	47.6	52.7	58.0	63.5
Worldwide Units (M)					
Consumer	48.3	49.9	56.5	63.2	68.7
Commercial	87.4	88.3	98.1	113.3	126.3
Total	135.6	138.2	154.6	176.5	195.0
USA Growth (%)					
Consumer		9.8%	17.3%	7.8%	5.7%
Commercial		-0.1%	7.2%	11.4%	11.9%
Total		3.2%	10.8%	10.0%	9.6%
Worldwide Growth (%)					
Consumer		3.3%	13.3%	11.8%	8.7%
Commercial		1.1%	11.0%	15.5%	11.5%
Total		1.9%	11.9%	14.2%	10.5%

SOURCE: IDC WORLDWIDE QUARTERLY PC TRACKER, AUGUST 2004



Between us end users and the OEMs, mobo manufacturers are busy. Allen estimated that the number of motherboards made for retail and the number produced for OEMs is about 50/50. He added that while some OEM motherboards are identical to retail mobos, others are custom-built to suit PC makers' needs.

To meet this demand, mobo companies have constructed enormous plants. ASUS' main plant in Suzhou, China, covers over 133 acres, the surface area of a small village or 100 football fields. It can produce 2 million motherboards, 120,000 laptop computers, and 600,000 graphics cards in a single month.

Game developer Valve also released a survey of its own through its Steam Web site (its new site where you may someday be able to download a full copy of Half Life 2). The survey asked customers about their hardware configurations, and over 730,000 gamers responded at the time of this writing, with some interesting results.

The CPU manufacturer of choice is still a close race between Intel and AMD, with 53% of respondents choosing Intel and 47% opting for AMD—not bad for AMD, which has had trouble making headway in the OEM market. Almost 50% of respondents use processors clocked between 1.7 and 2.7GHz. At first glance, it may seem like relatively few gamers have the latest CPUs, but the survey lumped AMD and Intel processors together. Because Intel's processors have higher clock speeds than their AMD counterparts, these results might be a little skewed.

RAM and hard drive usage was less ambiguous. Seventy-five percent of respondents had at least 256MB RAM. About 25% had between 512MB and 1GB, but less than 1% had more than 1GB of RAM. Seventy to 80GB hard drives were the most common (22%), but 30 to 40GB (18%) and 110 to 120GB (13%) hard drives were also very popular. About 5% of respondents had over 250GB hard drive space.

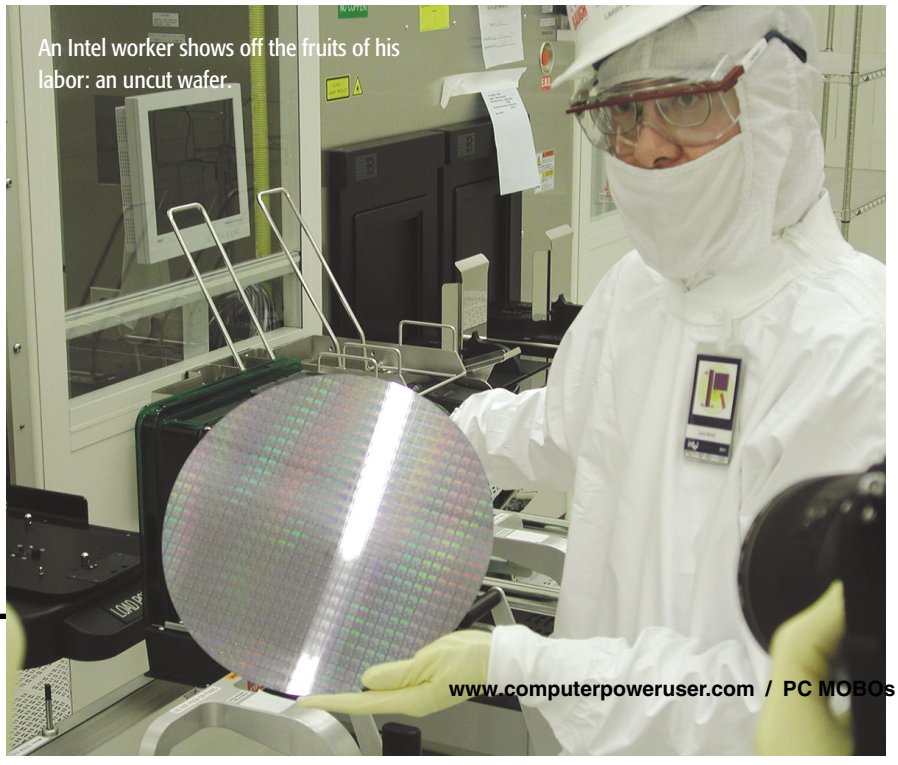
The survey also showed that the battle between ATI and NVIDIA is as heated as the one between AMD and Intel. While the NVIDIA GeForce4 MX series leads the pack of GPUs (12%), ATI's 9800 series is not far behind (10%). Relatively few people have purchased either company's flagship GPU: 1,761 respondents indicated they own an ATI Radeon X800 XT Platinum Edition graphics card, and 1,576 people have an NVIDIA GeForce 6800 Ultra board.

Same Old PCB, Brand New Faces

Sockets. A few months ago, we could recite the standard socket and bus configurations from memory without uncertainty. If you had the latest Intel-based rig, your mobo had a 478-pin socket (Pin Grid Array); AMD enthusiasts typically chose between Socket 754, A, 940, or 939 configurations. Regardless of your CPU of choice, you relied on AGP for your graphics card and about four to six PCI slots to tackle your various peripheral needs. Likewise, unless you had a penchant for RDRAM, you probably used DDR RAM in DIMM slots.

Now, we're starting to see plans for mobo enhancements come to fruition. The CPU socket has recently undergone an interesting renovation. For years, processors' pins (or legs) matched up with corresponding holes in the socket, called Pin Grid Arrays. A lever on the side of the socket controls pressure on the processor's legs. However, CPU pins are the most fragile part of the CPU, and it's quite easy to bend or break them.

Intel has begun to adopt a new standard for connecting processors to its sockets: the Land Grid Array (LGA). With LGA sockets, the pins are part of the socket itself, and an LGA socket's contacts match up with an LGA processor's lands, or conductive pads. To secure the CPU, a load plate applies enough pressure to keep the processor in contact with the socket. For now, only Intel processors come in an LGA variety; LGA sockets are most common on mobos with Intel's 915 (formerly code-named Grantsdale) and 925 (formerly code-named Alderwood) chipsets. AMD-philes will have to stick with PGA CPUs and sockets for now.



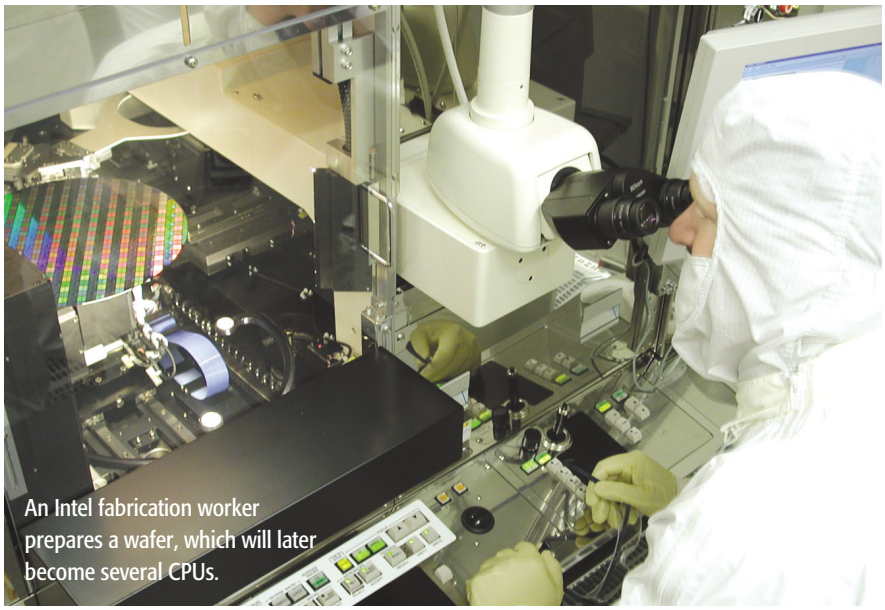
An Intel worker shows off the fruits of his labor: an uncut wafer.

Memory. Though it's still probably not as common as LGA CPUs and sockets, DDR2 RAM is the next permutation of computer memory, one which finally gained JEDEC (Joint Electron Device Engineering Council) approval in January 2004. In addition to the number of technological improvements over DDR, DDR2 also requires a new type of RAM slot, which has started to appear on a growing number of next-gen mobos. The new slots will be able to accommodate DDR2's 240 pins and will not be backward compatible with DDR RAM, which has 184 pins.

PCI-Express. PCI Express is arguably the most exciting recent change mobos have experienced and will single-handedly make both AGP and PCI obsolete in a matter of time. PCI-E is different from PCI in several ways. First, the PCI bus was a shared bus, meaning each PCI slot had to share bandwidth from the PCI bus' total bandwidth. Although different PCI versions boasted higher bandwidth, the fact that the bandwidth was shared never changed. For example, a motherboard with a standard 32-bit PCI has the same bandwidth to share whether it has four PCI slots or six.

PCI-E utilizes a bi-directional bus, meaning it has one path for sending data and one path for receiving data. These two paths compose a lane, and one lane can reach a theoretical bandwidth of 250MBps. When you consider that a single PCI-E lane has as much bandwidth as most PCI buses, PCI-E is a significant improvement. Mobos employing a PCI-E bus typically have two to three PCI x1 slots, which remain suitable for sound cards, NICs, etc.

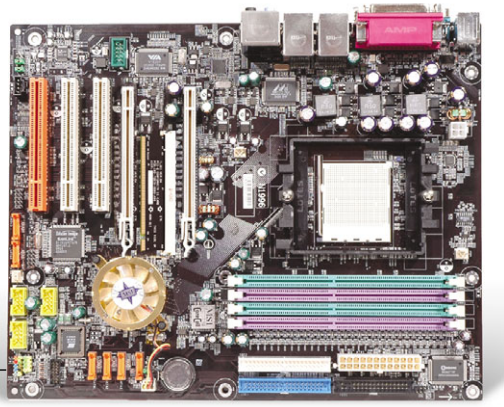
PCI-E lanes can also be combined up to a theoretical maximum of 32 lanes, but PCI x16 (16 lanes) slots currently sport the most lanes. This alone is enough bandwidth to thoroughly embarrass the fastest AGP slot on the market: AGP 8X tops out at 2.1GBps, while PCI x16 clips along at 4GBps, roughly twice as fast. End-user demand will ultimately decide the fate of AGP, but it's already clear that the PCI-E bus holds more technological promise than AGP.



An Intel fabrication worker prepares a wafer, which will later become several CPUs.

PCI-E also supports QoS capability, which organizes time-sensitive packets of data. As a result, data sent over the PCI bus is prioritized so all-important video and audio can reach you without skipping a frame or beat.

From a design standpoint, PCI-E slots may offer some improvements over PCI-32. One reason speedier 64-bit PCI slots are uncommon on ATX form factor (the most common form factor found in desktop PCs) is that the slots were longer, making mobo layout more difficult. While placing PCI-32 slots on an ATX mobo has never been difficult, PCI-E x1 slots are significantly shorter; better internal case airflow should be one additional benefit from PCI-E x1 slots. PCI-E x16 slots for compatible graphics cards aren't significantly shorter, however.

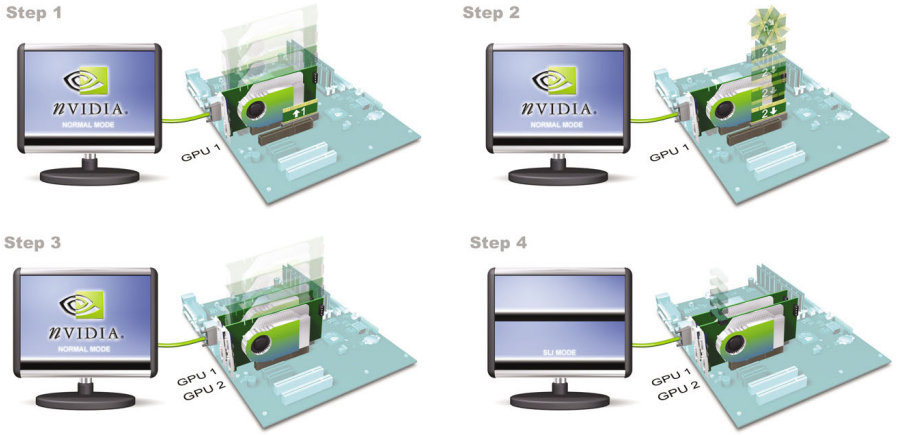


MSI's SLI K8N sports two fancy PCI-E x16 graphics slots, ready for NVIDIA's SLI technology.

Chipsets. The major chipset manufacturers are hot on the heels of Intel, which has already released a series of chipsets that support PCI-E. The 915P/G are targeted for the mainstream PC market and are appearing in midrange systems from major PC manufacturers such as Dell. Both of these chipsets support Intel Pentium 4 CPUs, but you'll have to step up to the 925X chipset if the P4 Extreme Edition is your flavor of choice. Otherwise, the 915P/G and 925X chipsets share most of the same features.

All three support an 800MHz system bus (the 915P/G also supports a 533MHz system bus) and the new LGA775 processor socket. Each chipset can support up to four PCI-E x1 slots.

All three chipsets will support dual-channel DDR2 533/400 RAM, but the 915P/G also supports dual-channel DDR 400/333. Intel claims support for up to 4GB RAM, but we wouldn't recommend dropping several hundred dollars for that much memory. DDR is technologically on its way out the



Remember 3dfx? NVIDIA is the latest company to combine the graphics processing power of two GPUs into a 3D visual feast.

door, and DDR2 hasn't yet fully matured. The 925X supports both ECC memory and non-ECC memory.

For graphics, all three chipsets will utilize a PCI-E x16 slot, and the 915G also wields Intel's Graphics Media Accelerator 900. The onboard video accelerator has a 333MHz core speed. Its performance is largely determined by the amount of system memory you have, but anyone with a remote interest in gaming will obviously want to purchase a separate video card.

VIA Technologies recently responded to the gauntlet Intel has thrown down, announcing the future release of new chipsets for both AMD and Intel processors. As an alternative to the Intel 915 or 925 chipsets, VIA will be launching the PT894 and PT894 Pro. Both of these new chipsets will support a PCI-E x16 graphics bus and two PCI-E x1 connections, DDR2, and FSB speeds of up to 1066MHz. The PT894 Pro will also feature VIA's proprietary DualGFX Express support, which should be able to harness the power of dual PCI-E graphics. The PT894 and PT894 Pro are compatible with Intel CPUs.

While the PT894 and PT894Pro give consumers an alternative chipset for their Intel processors, VIA's K8T890 could be the alternative PCI-E solution AMD fans have been waiting for. Designed for AMD Athlon 64, Athlon 64 FX, Opteron, and Sempron processors, the K8T890 has one PCI-E x16 connection with up to 4GBps bandwidth for graphics and four PCI-E x1 connections. The PCI-E x1 connections will offer the standard 250Mbps per direction bandwidth. The K8T890 also uses FLEX Express architecture, which connects up to four PCI-E x1 links directly through the K8T890 chipset's northbridge. This clears up I/O bandwidth in the southbridge for more hard drives, optical drives, or USB and FireWire devices.

While the K8T890/8251 looks like a solid chipset, you may find it worthwhile to wait until the K8T890 Pro debuts. Like the PT894Pro, this souped-up chipset should have two PCI-E graphics slots.

VIA's new VT8251 southbridge should bring as many improvements as its upcoming line of northbridge chips. The VT8251 will support two more PCI-E x1 slots as well as SATA2. It will also support Azalia HD Audio. According to Keith Kowal, international marketing manager at VIA, VIA plans to support Gigabit Ethernet through the PCI-E bus, and Kowal said VIA may also extend PCI-E support to the older VIA northbridges using the VT8251 and VIA's V-Map Express architecture.

NVIDIA and ATI, long-time graphics rivals, look to take their competition to the chipset playing field, as well. NVIDIA is already a seasoned veteran, but ATI also has plans to release motherboards sporting proprietary chipsets that support PCI-E.

NVIDIA's nForce chipsets have become quite popular among AMD enthusiasts, so there's little doubt that its nForce4 chipset will be ushered in with immense fanfare. The nForce4 will bring PCI-E to AMD's Athlon 64, Athlon 64 FX, and Sempron CPUs, and it will be a single chip like the nForce3.

All eyes will be especially focused on NVIDIA's nForce4 SLI model. While the other two nForce4 models, the nForce4 and nForce4 Ultra, also support PCI-E, the nForce 4 SLI will be specially configured to support dual PCI-E graphics cards; two compatible NVIDIA graphics cards will share the x16 link as two x8 links, generating additional graphics power. SLI technology isn't new; 3dfx pioneered the idea with a technology sharing the same acronym, although it called the advancement scan-line interleave. Anyone lucky enough to have the spare dough for two PCI-E NVIDIA GeForce 6800 Ultra graphics cards should love this development.

NVIDIA's nForce 4 is the latest entry in the PCI-E compatible field of chipsets.

ATI's new chipsets, although not available at press time, should be available very soon. The RX480 and RS480 will also support AMD's top-end Athlon 64, Athlon 64 FX, and Opteron CPUs. The crucial difference between the two chipsets is that the RS480 is slated to have an integrated graphics solution, while the RX480 will not.

Put It All Together

Assembling this jigsaw puzzle of components is quite a tall order for motherboard

VIA's K8T890 and K8T890PRO will compete with NVIDIA for AMD-based PCI-E chipset market share.

manufacturers. In addition to battling for enough of the latest chipsets (for example, Intel always has dibs on its own chipsets when it makes motherboards), mobo manufacturers have to contend with the fact that while the changes to sockets, RAM, etc., are exhilarating from a power user's standpoint, a sizeable number of users are still locked into 478-pin sockets, DDR RAM, and AGP graphics cards.

"As long as there is a demand in the market, AOpen will continue to manufacture the 478-pin motherboard, as well as the 775." said Charlie Shiang, VP of Sales-Peripherals at AOpen. "We're going to manufacture both DDR and DDR2 [DIMM slots]. It will depend on which platform is more popular."

While companies such as AOpen are keeping an eye on markets for the older technologies, it's clear that everyone is moving ahead. For example, Intel projects that 50% of its platforms will use PCI-E x16 slots for graphics cards exclusively by the end of 2004.

"PCI Express was off to a mild start, but now that PCI-E graphics cards are ramping up, the PCI-E motherboard sales are doing even better," ASUS' Allen said.

"With PCI-E, SATA2, [IEEE] 1394b, (and) DDR2, a lot has already happened this year," he added.

Companies such as ASUS and AOpen have already incorporated a lot of this technology into mobos that are currently available. ASUS' P5AD2, P5GD2, and flagship P5AD2 Premium support Socket 775 Intel processors, DDR2, and PCI-E. The P5AD2 Premium harnesses IEEE 1394b, which can sustain twice the bandwidth as IEEE 1394a.

AOpen has released an eclectic mix of new motherboards that offer a variety of configurations. The i915Ga-E, i915Gm-I, and i915Pa-E support Socket 775 Intel processors and PCI-E but use older DDR

Other Happenings In The Mobo World

Here's a quick roundup of some happenings from other motherboard companies

Chaintech

At press time, Chaintech had introduced three Socket 775 mobos based on Intel's 915 and 925 chipsets–the V925X Zenith VE, Z925X Zenith, and V915P. Both the V925X Zenith VE and Z925X Zenith have a Socket 775, DDR2 DIMMs (up to 4GB DDR2 400/533 ECC and non-ECC memory modules), one PCI-E x16 slot, two PCI-E x1 slots, and three PCI slots. In fact, the only noteworthy difference between the two mobos is that the Z925X Zenith has support for IEEE 1394a. The V915P differs from the other two in that it uses Intel's 915 chipset, supports LGA 775 Celeron D processors in addition to LGA775 Pentium 4 processors, and does have RAID capability.

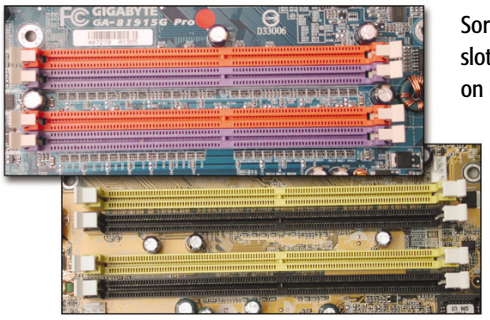
Foxconn

Foxconn, like Chaintech, has embraced Intel's 915 and 925 chipsets, offering a total of five motherboards between the two chipsets. The 925A01-8EKRS2, its flagship mobo, uses the Intel 925X chipset. This board has almost identical specifications as the Chaintech Z925X Zenith, except the 925A01-8EKRS2 has three PCI-E x1 slots and only two PCI slots. Foxconn's two 915P-based boards, the 915A01-8EKRS2 and 915A01-8EKRS, are essentially the same. The difference is that the 915A01-8EKRS2 uses 1.8V DDR2 400/533 and the 915A01-8EKRS supports 2.5V DDR2 266/333/400. The 915G-based boards differ from their 915P cousins by using a Micro ATX form factor and having Intel's integrated Graphics Media Accelerator 900.

memory. The i915Ga-EFRII and i915Pa-EFII also use Socket 775 processors and a PCI-E bus (x16 and x1) and also support DDR2 533MHz RAM.

AOpen also appears to be taking an interesting risk with its i855GMEm-LFS mobo. The board has a Micro ATX footprint, making it suitable for a desktop PC; yet, it uses an Intel Pentium M processor (Banias or Dothan core). It doesn't have the same features as a lot of new high-end motherboards (only two DIMM slots for DDR333 RAM, 400MHz FSB, 4X AGP slot), but Intel has shown signs it will be moving to the Pentium M core for future desktop CPUs. Even if releasing the i855GMEm-LFS this early may only establish the mobo in a niche market, it should give AOpen valuable experience integrating future descendants of the Pentium-M into desktop models.

AOpen is currently not planning to produce a motherboard based on the 925 chipset, but the company is watching the market closely.



Sorry DDR, you're not allowed: New DDR2 DIMM slots (below) have 240 contacts to match the pins on DDR2 memory modules. Old DDR DIMM slots have 184 contacts.

"We don't have a plan right now for 925. We have a prototype developed, but we don't have a set or fixed manufacturing date because we're waiting for the market to be mature in this segment because this segment is more focused on the workstation. The 915 chipset should be sufficient even for the workstation solution with the features we added. The only difference between the 915 and the 925 is the ECC memory," said Chiang.

It seems that some of the biggest mobo news centers around NVIDIA's nForce4 chipset. On Oct. 19, NVIDIA made the nForce4 official, and ASUS responded with the A8N-E Deluxe. This particular motherboard looks poised to take its place as the AMD-based counterpart of the Intel-based P5AD2 Premium. Designed for Socket 939 Athlon 64/64 FX processors, the A8N-E Deluxe's biggest selling point is its ability to support NVIDIA's new SLI technology. According to Allen, the A8N-E Deluxe will support two identical NVIDIA PCI-E graphics cards; it looks like those that favor ATI will be out of luck.

AOpen has also released two mobos based on the nForce4 chipset—at the time of this writing, the nCK804Ua-LFS and nCK804a-LFS-based on the NVIDIA nForce4 Ultra and nForce4, respectively. CPU

by Vince Cogley

GIGABYTE

GIGABYTE consistently delivers some of the most feature-laden mobos on the market, and its 915- and 925-based boards are no different. By now, you can probably recite the salient features of these mobos without a moment's pause, but GIGABYTE offers some enticing bonuses power users will likely embrace. The GA-8ANXP-D (925X-based) and GA-8GPNXP Duo (915P) sport such über-sexy extras as GIGABYTE's proprietary U-Plus D.P.S. and an 802.11b/g WLAN card. Neither board has fewer than four SATA connectors. Both support IEEE 1394b. Expect GIGABYTE to roll out similar boards for AMD CPUs once the VIA K8T890 and NVIDIA nForce4 become readily available.

MSI

Like Foxconn, MSI has one 925X-based mobo and two mobos for each version of the 915 chipset. The 925X Neo Platinum-54g is the leader of the pack with support for 4GB DDR2 533 RAM, Dual LAN (one 10/100/1000 controller and one 10/100 controller) and 802.11g WLAN to satisfy power networkers, plenty of RAID options (0, 1, 0+1, Matrix), and eight-channel Azalia audio.

With such sweeping changes to mobo configurations, power users are likely to be content for a while. Manufacturing plants appear to be in full swing, and consumers seem to be gobbling up new motherboards as quickly as companies can produce them. ASUS's Rick Allen foresees no product shortages in the future (with the exception of the demand for high-end graphics cards possibly exceeding companies' supply). 2004 has definitely been a good year for motherboards.

MOBO CONFIGURATIONS

Various Form Factors Have Shaped The History Of The Motherboard

The motherboard is the central component in your PC, yet advances in motherboard technology rarely receive the same attention that processor, memory, and video card technologies receive. The motherboard has undergone a series of changes during the era of the home PC. Because one form factor, ATX, has dominated the home PC market for so many years, it's the type of motherboard with which we're most familiar. In fact, unless you've been building PCs for more than seven years, it is likely that you don't even realize how much easier it is to build a computer today or how much better motherboards are designed.

Over time, motherboards have shrunk, consuming less space in cases. There are fewer problems with system components intruding upon each others' space, and the layout of the motherboard results in improved airflow. Not only do newer form factors generally spread components out better, but they also tend to place the hardware that needs the most cooling, such as the CPU, in positions on the motherboard which are least restricted and closest to the path of air flowing through the case.

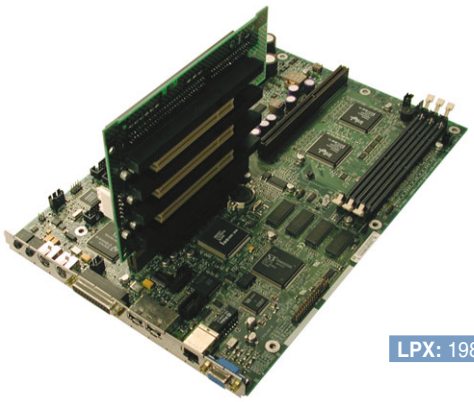
Users will also find that modern motherboards are much easier to use than earlier form factors. For instance, older motherboards required users to connect I/O ports, PS/2 mouse ports, and other devices to headers (groups of pins) on the motherboard; whereas, today's motherboards have ports that are soldered onto the motherboard, reducing the number of tangled cables in the case and also eliminating potential errors and conflicts for PC builders.

Despite their many differences, all motherboards old and new have several things in common. All motherboards have a socket for at least one processor. What has changed is the position of the motherboard socket. You will even find that some motherboards (such as a few tiny Mini-ITX boards) have the processor soldered onto the board.

All motherboards have connectors for a power supply, but different form factors use different types of connectors and are compatible with different power supplies, so a power supply that works with an old AT board will not work with one of today's ATX or BTX motherboards.

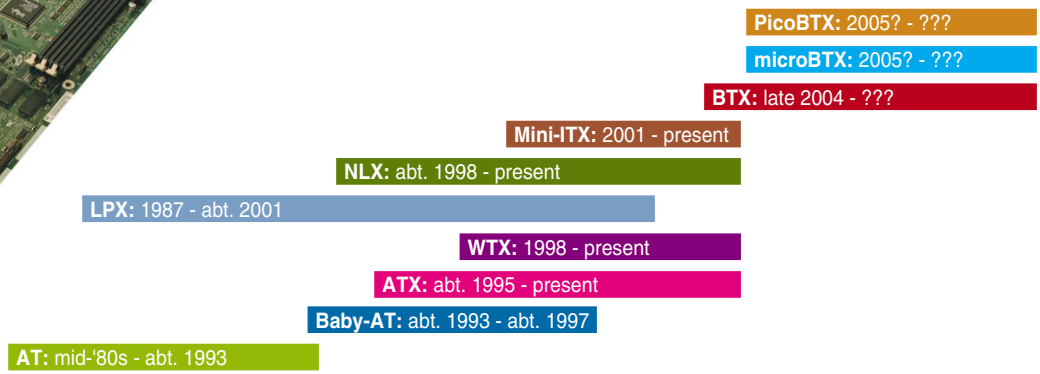
Although all motherboards provide slots for memory and some form of add-on capabilities, the way in which these add-on components connect to the motherboard have changed with improvements in progressive form factors. For example, some components now plug into a modern motherboard directly, whereas these same components required lengthy cables for connection to an older motherboard. (For an in-depth look at the many different types of motherboard connections, see the article "Sockets, Buses, Slots & Ports" on page 18.)

On the following pages, we'll take a look at the history of the motherboard. You'll be able to see how much this essential PC component has changed over time and what advantages certain form factors provide over others. ▲



Motherboard Timeline

There has been some overlap in the usage of motherboard form factors. The timeline below demonstrates the evolution of the motherboard.



AT/Baby-AT

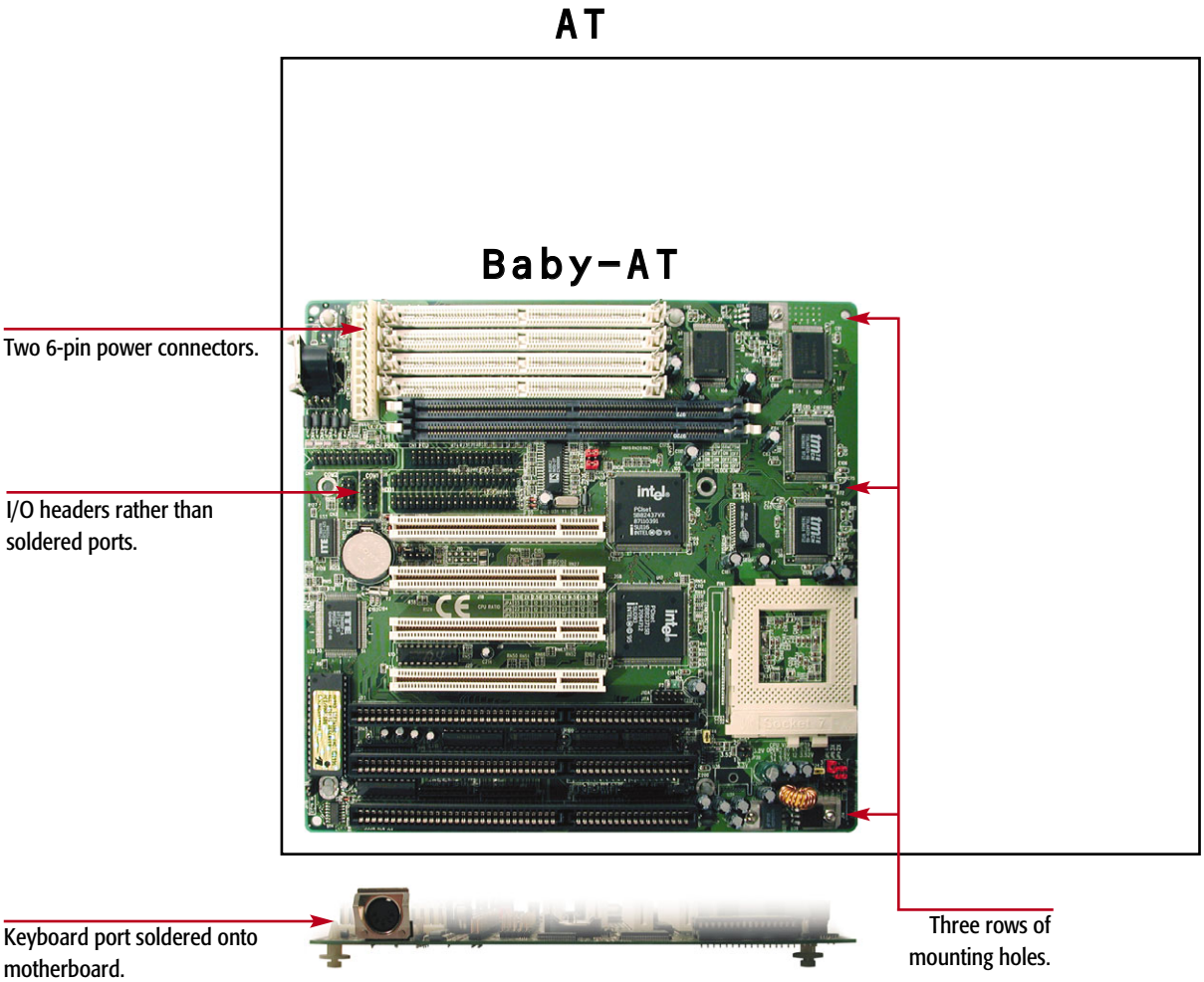
AT. This is the motherboard form factor that started it all. AT (later known as Full AT to differentiate it from its spin-off, the Baby-AT) stands for Advanced Technology. This form factor first emerged when IBM released the PC AT computer in 1984. If you have a chance to compare an AT motherboard to a modern motherboard, one of the first things you will notice about the AT board is that it is nearly as wide as it is long, whereas today's motherboards look more rectangular and are not as wide. Full AT boards will not fit in today's cases. Despite the fact that nearly every personal PC made from the mid-'80s until the early '90s had a Full AT motherboard, the form factor is obsolete today.

Dimensions: 12 inches x 13.8 inches

Trivia: The ATA hard drive gets its name from the AT motherboard form factor. ATA actually stands for AT Attachment.

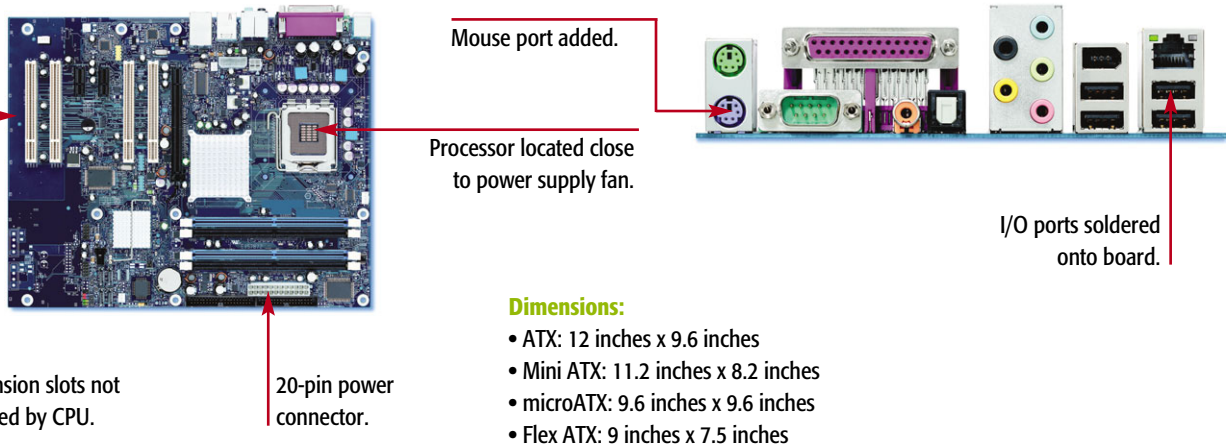
Baby-AT. The Baby-AT form factor addressed some of the shortcomings of the AT standard. Most significantly, Baby-AT boards were small enough to fit in cases without the CPU, heatsink, or memory blocking drive bays. Baby-AT boards were a lot like Full AT boards, except that they were 5 inches shorter in width. This eliminated the biggest problem with Full AT boards. Baby-AT systems had plenty of room for even the newer, larger processors and heatsinks. However, heatsinks, processors, and memory modules continued to consume more space inside the case. Baby-AT boards were extremely popular, but by 1997, Baby-AT had met the same fate as its predecessor, the Full AT form factor. Once Baby-AT boards could no longer simultaneously accommodate CPUs, memory modules, expansion cards, and hard drives, the ATX form factor emerged.

Dimensions: 13.04 inches x 8.57 inches



ATX

ATX, or Advanced Technology Extended, is the most common type of motherboard today. Intel developed the ATX standard, which was released in 1995. Although the ATX form factor offered many improvements over the older Full AT and Baby-AT formats, the adoption rate was somewhat slower. ATX boards have several requirements that are not compliant with those of AT boards. For example, ATX boards require an ATX power supply and an ATX case. These newer motherboards will not fit in an AT or Baby-AT case. One of the reasons ATX boards require an ATX power supply is because ATX motherboards have a 20-pin power connector rather than two 6-pin connectors. The ATX standard also provides a means for shutting down a system without physically flipping the power switch. Instead, software (such as Windows) can send a command to the motherboard to disable the power. Finally, ATX's wide popularity is evident by the number of ATX spin-offs. Three smaller ATX subform factors emerged, Mini ATX, microATX, and Flex ATX.


Mouse port added.
Processor located close to power supply fan.
I/O ports soldered onto board.
Expansion slots not blocked by CPU.
20-pin power connector.

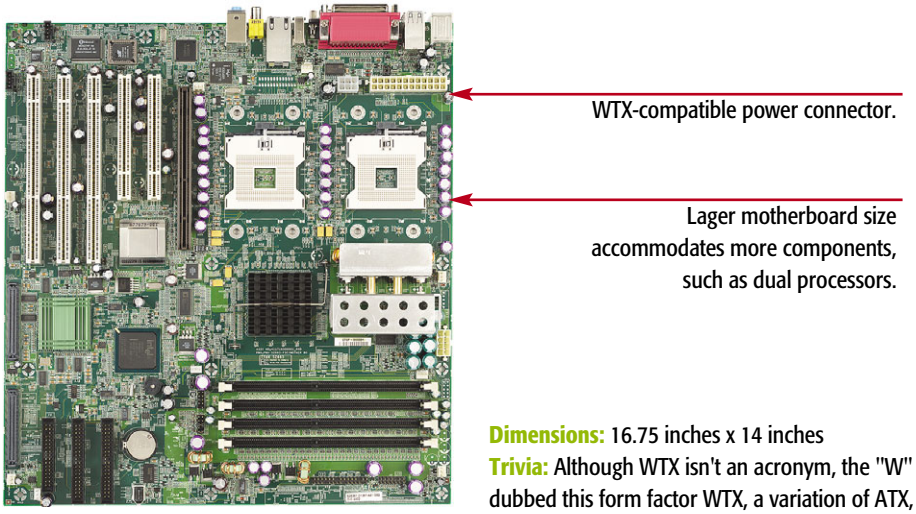
Dimensions:
- ATX: 12 inches x 9.6 inches
- Mini ATX: 11.2 inches x 8.2 inches
- microATX: 9.6 inches x 9.6 inches
- Flex ATX: 9 inches x 7.5 inches

Trivia: ATX is a trademarked name to which Intel holds the rights.

WTX

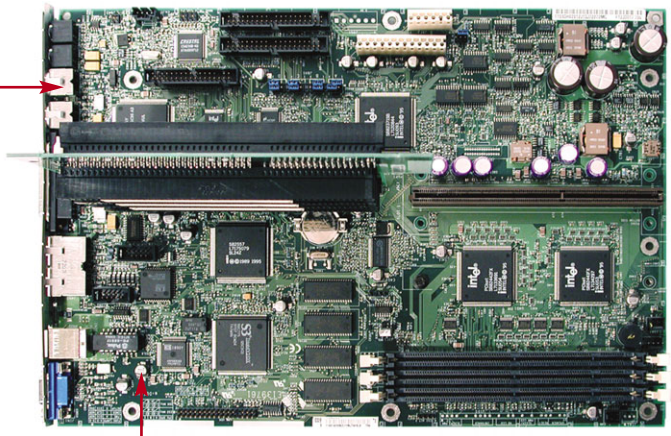
Introduced in 1998, WTX differs from the other form factors we've looked at in that it is built for servers and workstations. Just as the NLX form factor (see the NLX board entry) made it easier for computer manufacturers to access, repair, and replace components, the WTX form factor makes it easier for a business' IT department to access and work with components. WTX motherboards are much larger than ATX and other form factors, but the difference is more than just size.

For instance, the motherboard connects to a special mounting plate instead of attaching to the case with screws. Also, there is a separate I/O board for connecting add-ons such as PCI cards. The layout of the board is very specific, ensuring the best cooling and least electromagnetic interference. WTX boards require a WTX power supply, which provides more power than an ATX power supply. A WTX power supply has one 24-pin and one 22-pin connector, as opposed to ATX's 20-pin connector. WTX power supplies also have two optional connectors (8-pin and 6-pin), whereas ATX power supplies have only one optional connector.

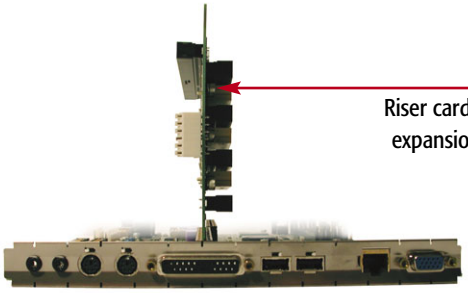


Dimensions: 16.75 inches x 14 inches

Trivia: Although WTX isn't an acronym, the "W" does stand for something significant. Intel dubbed this form factor WTX, a variation of ATX, with the "W" representing "Workstation."



Dimensions: 9 inches x 11 to 13 inches

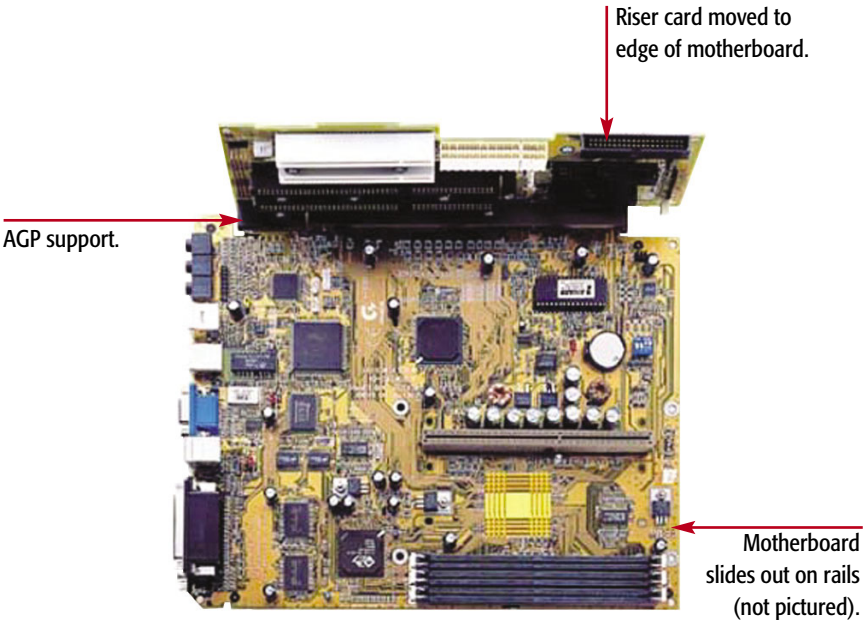


LPX

The LPX form factor is designed for prebuilt PCs, such as those made by Gateway or HP. LPX boards let companies produce relatively small PCs. In addition, system repairs are simplified by the use of a riser card. This riser card houses any expansion cards, including PCI cards, suspending them above the motherboard to reduce the height of the system. This also makes it easy to replace cards, as technicians only need to work on the riser card and not on the entire motherboard. One drawback, however, is that LPX motherboards only support up to three expansion slots, whereas many larger form factors support four to seven slots. One other drawback is that to reduce the size of the board, video capabilities are often built into the board, complicating upgrades for users who want to install add-on video cards.

NLX

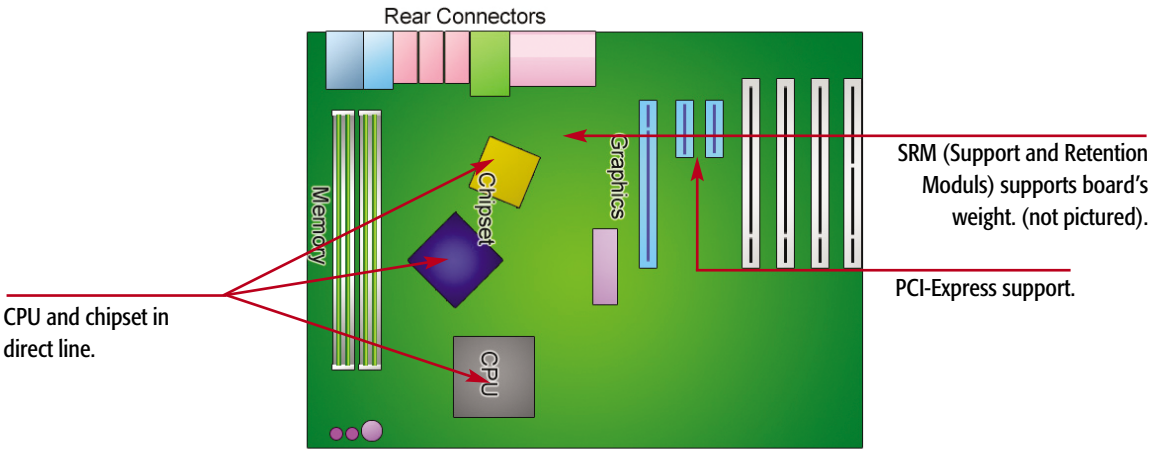
NLX motherboards are very similar to ATX boards and even use the same ATX power supplies. However, consumers are much more familiar with the ATX standard because NLX boards are used primarily by PC manufacturers such as Gateway and HP. If you've built a computer, you know that replacing an ATX motherboard takes a little bit of effort. You have to open the case and remove the mounting screws. In contrast, NLX boards mount in the case on rails and slide out of the PC. No screwdriver is necessary. Furthermore, most components do not mount directly onto the motherboard. Instead, the motherboard connects to a riser card that houses any expansion cards. The only components to install on the motherboard are the rails, processor, memory, and I/O shield. Intel introduced the NLX form factor in 1997, and it is still popular with PC manufacturers today.



Dimensions: 10 to 13.6 inches x 8 to 9 inches

BTX

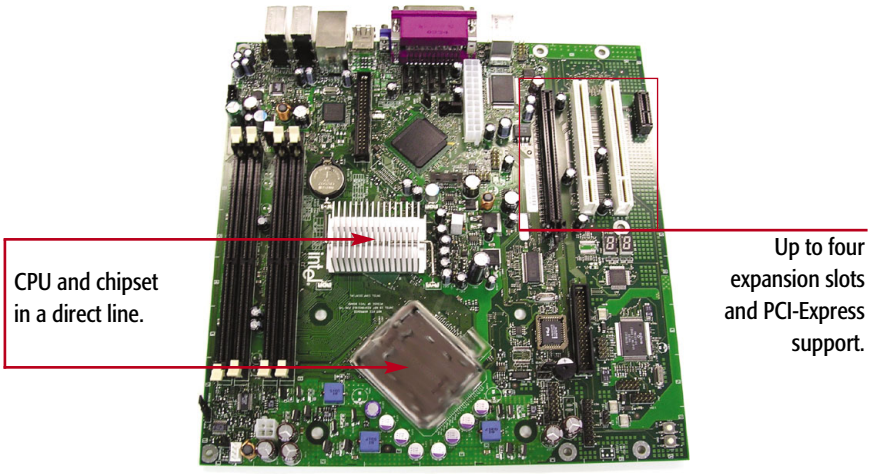
BTX stands for Balanced Technology Extended and is a form factor developed by Intel. This is the newest major motherboard technology available. It remains to be seen how popular it will be. Because BTX is scalable (see the MicroBTX and PicoBTX board entries), the form factor is ideal for building small systems. Similar to the Mini-ITX boards, BTX boards are laid out in such a way that parts installed on the motherboard don't block airflow. Because of this, BTX systems will run cooler than most ATX counterparts. BTX boards are also designed for today's components, which tend to be much bulkier and heavier than those that existed in the early days of ATX. The first BTX boards appeared in 2004, so it's still too soon to know how quickly users will adopt the BTX standard.



Dimensions: 12.8 inches x 10.5 inches

Micro BTX

microBTX will be to BTX what MicroATX is to ATX. This form factor will provide many of the same benefits as BTX, but it will support smaller systems. Although all BTX boards have a specified depth of up to 10.5 inches, the maximum length of a microBTX board will be just 10.4 inches. Although the microBTX form factor is more than 2 inches shorter than its full-sized counterpart, a microBTX board can still support up to four expansion slots.

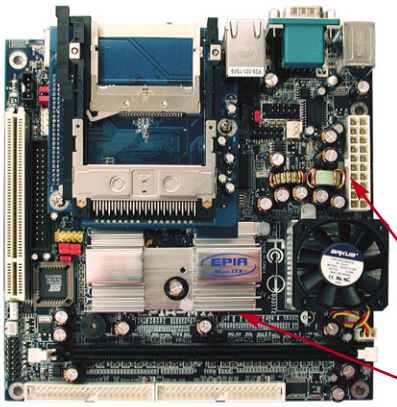


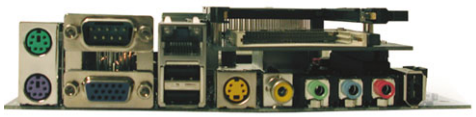
Dimensions: 10.4 inches x 10.5 inches

Mini-ITX

If reducing a PC's size is your goal, you currently need to look no further than the Mini-ITX form factor. These motherboards are exceptionally small. The specification dictates that Mini-ITX boards shall be no larger than 6.7 inches x 6.7 inches. In early 2001, VIA announced the ITX form factor, which measured just 8.5 inches x 7.8 inches. However, manufacturers shunned ITX in favor of FlexATX (9 inches x 7.5 inches), which was only slightly larger than ITX. FlexATX boards were compatible with other ATX components, whereas ITX systems required a special slim-line power supply. In November 2001, VIA introduced the Mini-ITX form factor, which is still growing in popularity today.

VIA is still the primary manufacturer of Mini-ITX motherboards and solders processors onto the motherboard, limiting the upgrade path. However, Mini-ITX is not aimed at power users. Instead, Mini-ITX systems are ideal for creating music and video servers small enough to blend in seamlessly with home theater equipment or for building small PCs for word processing, email, and other basic tasks. Mini-ITX boards have very low power requirements. We built a Mini-ITX system a few months ago that had a 60W power supply. Because of the low voltage and airflow-efficient design, most Mini-ITX systems need no CPU fans.





Dimensions: 6.7 inches x 6.7 inches

Trivia: Mini-ITX boards arrived before Mini-ITX cases were widely available. As a result, creative users built Mini-ITX systems in pizza boxes, toasters, and cigar boxes. Today, Mini-ITX boards are more common, but people still mount Mini-ITX boards in interesting enclosures to create eye-catching mods, such as the Log Cabin PC (www.mini-itx.com/projects/logcabinpc) and the LunchBoxPC (www.mini-itx.com/projects/lunchboxpc).

Trivia: VIA plans to release the first dual-processor Mini-ITX board in 2005.

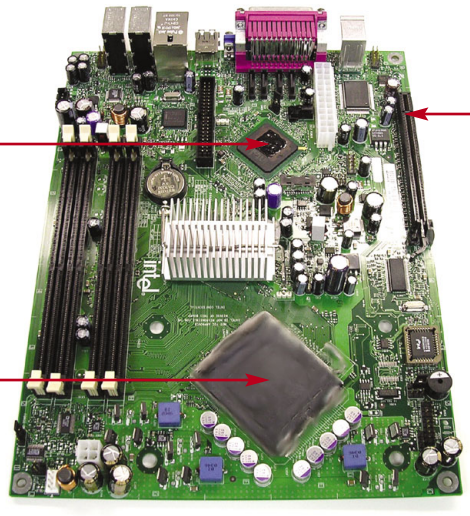
Low-power power connector.

Some boards require no CPU fan. The processor is often soldered onto the board.

Pico BTX

If microBTX is small, picoBTX is downright tiny. There are currently no picoBTX boards on the market, but once they do arrive, you can expect to see motherboards as small as 8 inches x 10.5 inches. These boards will support the same technologies as the BTX and microBTX boards and will incorporate the same airflow-efficient design. However, due to the small design of the picoBTX board, only one expansion slot will be possible on each motherboard. CPU

by Kylee Dickey



CPU and chipset in a direct line.

One expansion slot and PCI-Express support.

Dimensions: 8 inches x 10.5 inches

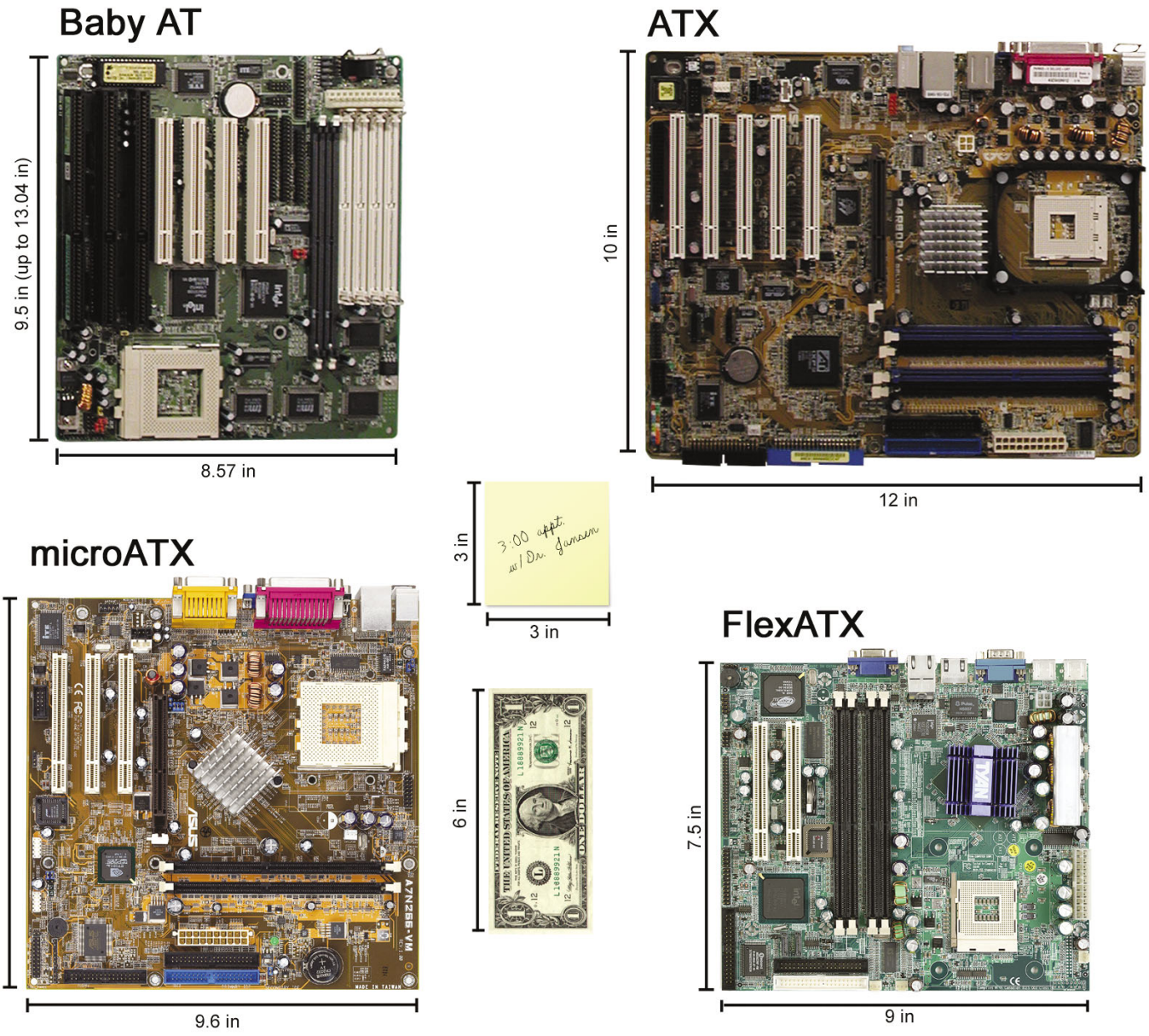
Motherboard Moving On

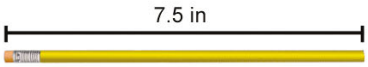
The motherboard is the primary component of a PC, so it is no wonder that it has gone through so many transformations in its lifetime. With the recent release of the BTX form factor, we are most likely approaching the next chapter of the motherboard's story. ▲

Compiled by Kylee Dickey
Graphics & Design by Andria Schultz

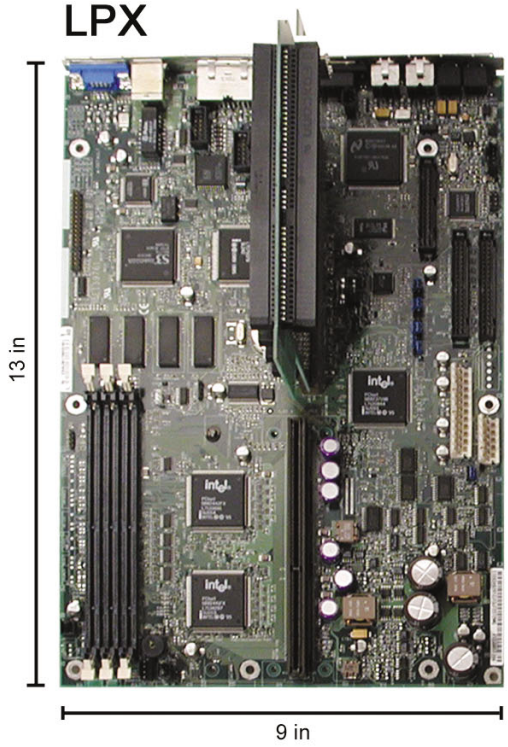
To Put Things In Perspective

It's one thing to read about integrated features and sizes of various form factors, but it's another entirely to see how different these motherboards really are. Here you can see the relative sizes of various motherboard form factors and how they have changed over the years.

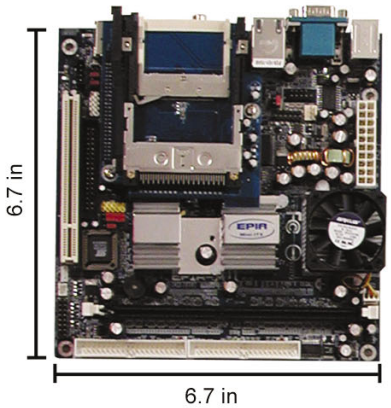




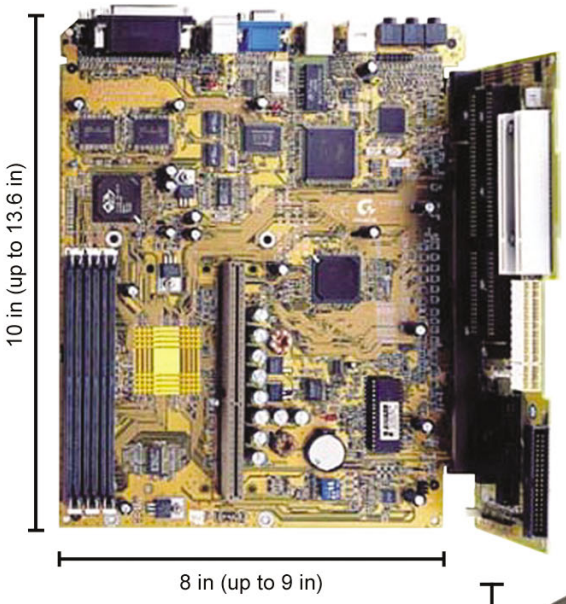
LPX



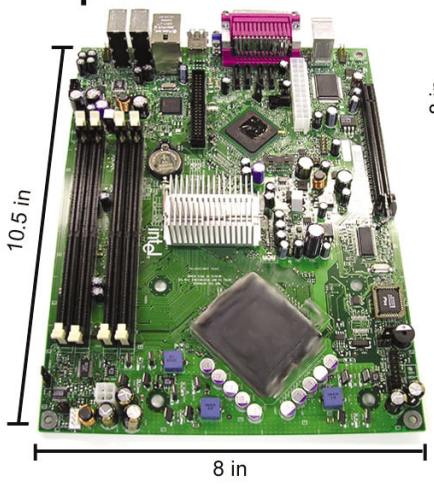
Mini-ITX



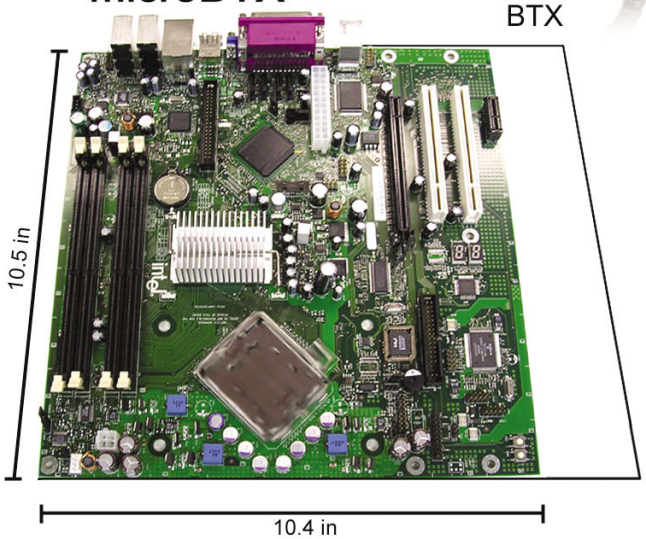
NLX



picoBTX



microBTX



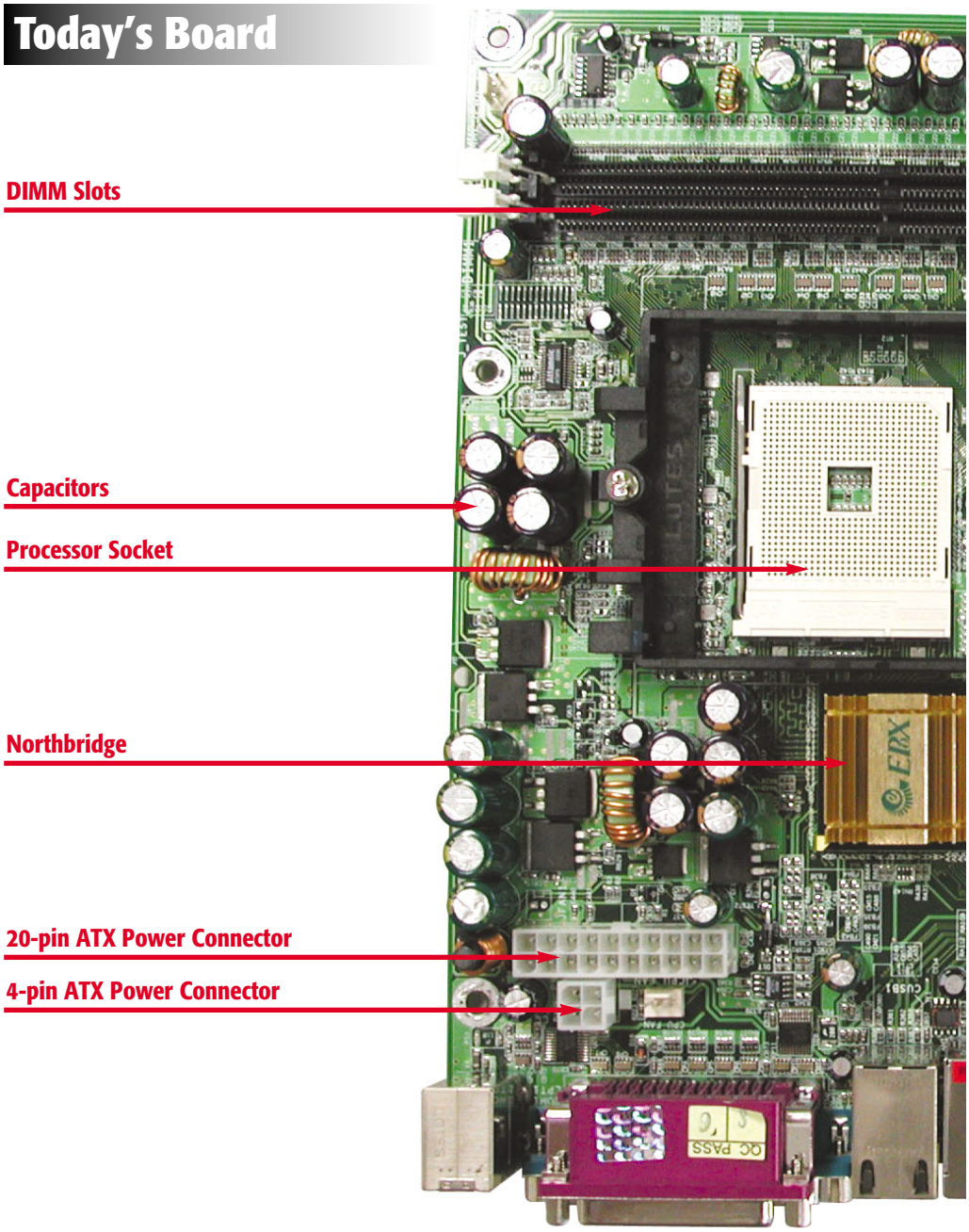
Sockets, Buses, Slots & Ports

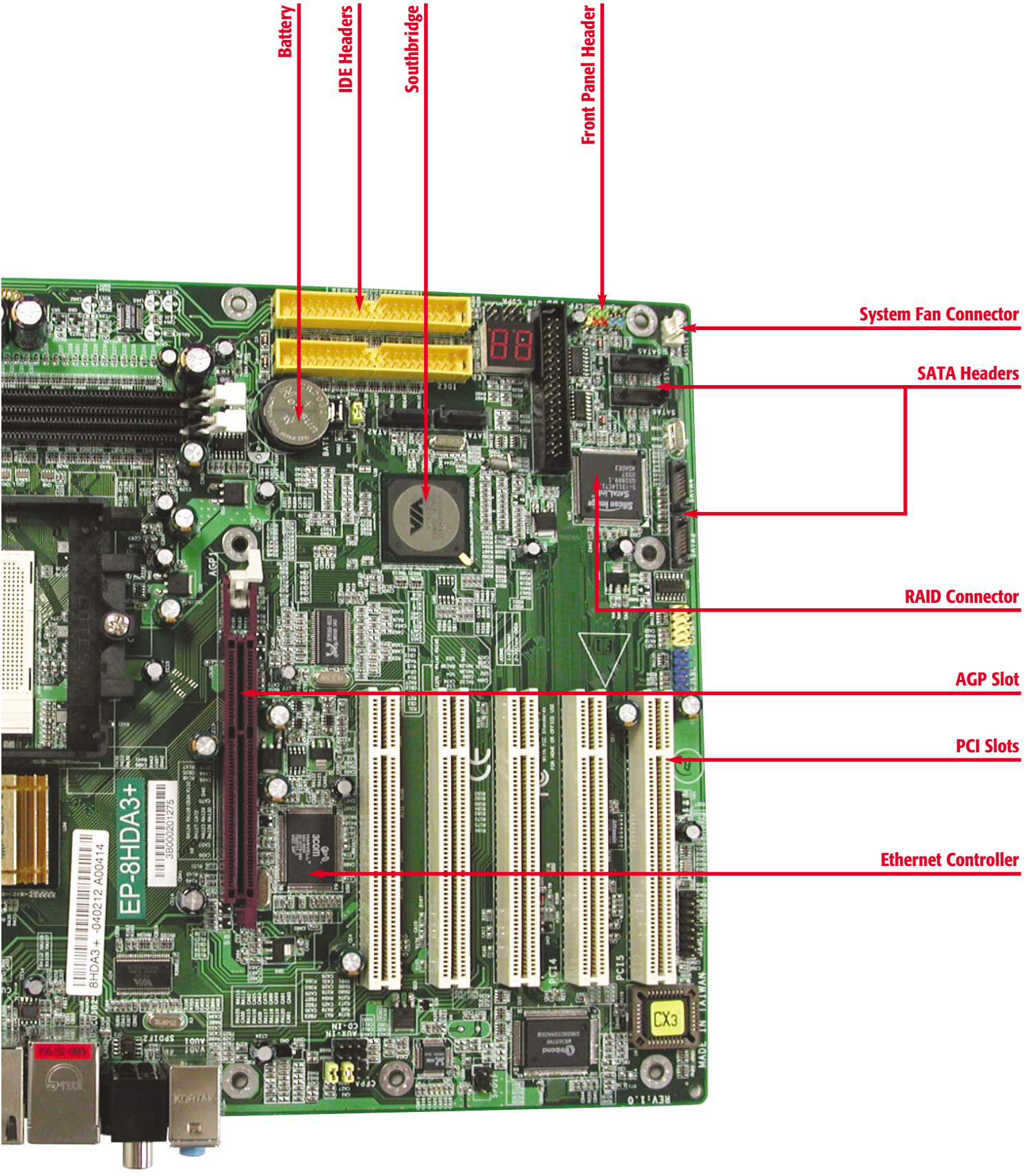
What Goes Where On Most Mobos

If you haven't purchased a mobo recently, you may be in for a surprise when you see your next board. Rapid changes in bus and socket technologies keep altering the landscape of today's motherboards. Sure, that old PS/2 mouse port may look familiar, but throw in a couple of new PCI Express slots and one of the new chip sockets and you can quickly find yourself in foreign terrain. Similar recognition problems may crop up when you're retrofitting an old board. To help you ID the new stuff—or jog your memory with the old—here's a quick lineup of the connectors you'll run into on most boards.

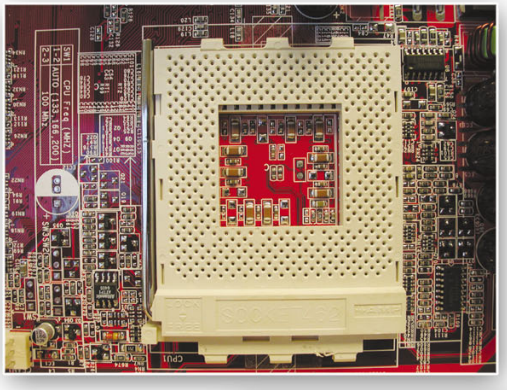
The EPoX 8KDA3+ pictured at the right is just one example of the vast number of available motherboards. Shown are some of the components and elements that make up a typical modern mobo.

Today's Board

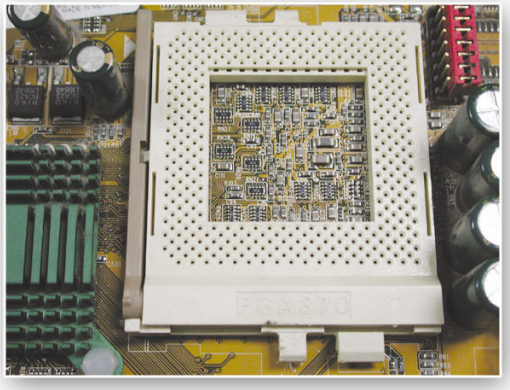



Battery
IDE Headers
Southbridge
Front Panel Header
System Fan Connector
SATA Headers
RAID Connector
AGP Slot
PCI Slots
Ethernet Controller
EP-8HDA3+

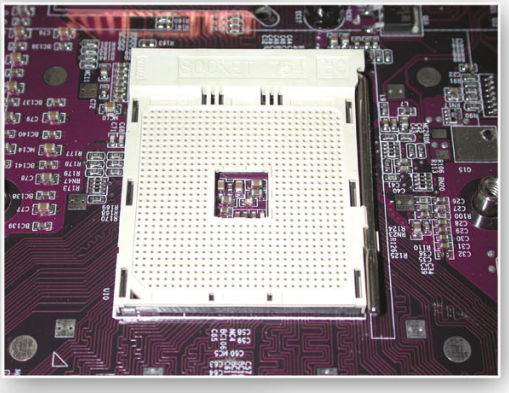
SOCKET TYPES



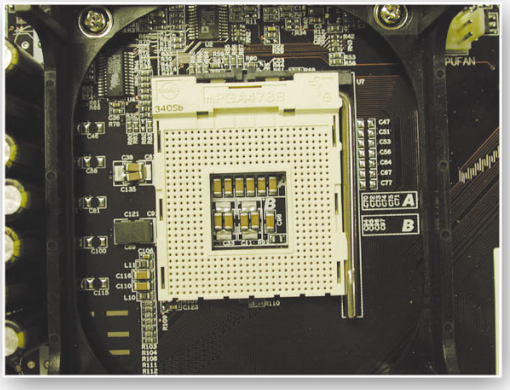
Socket 462/A
(for AMD CPUs)



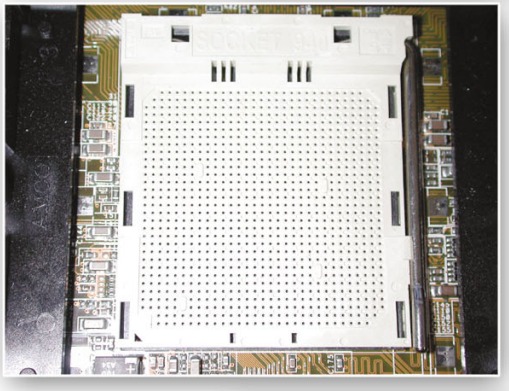
Socket 370 (for Intel CPUs)



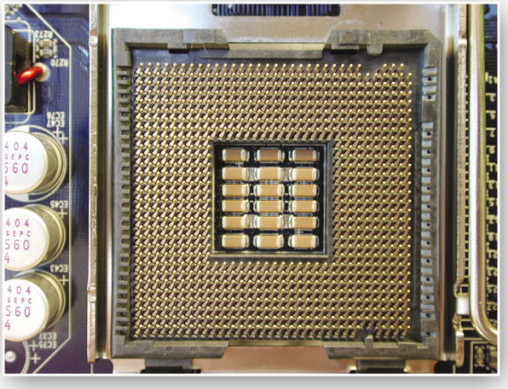
Socket 754
(for AMD CPUs)



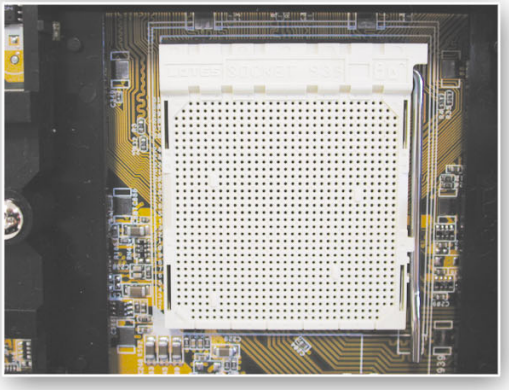
Socket 478 (for Intel CPUs)



Socket 940
(for AMD CPUs)

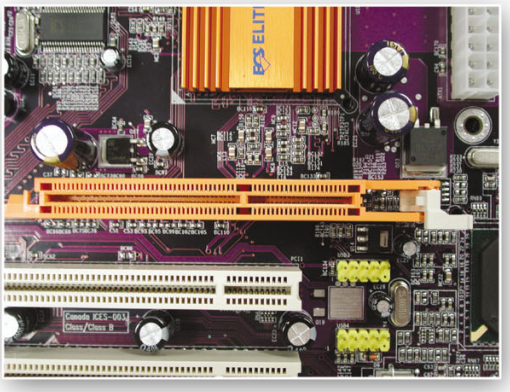


Socket LGA 775 (for Intel CPUs)

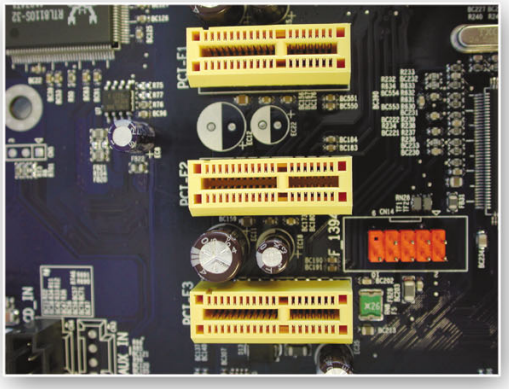


Socket 939
(for AMD CPUs)

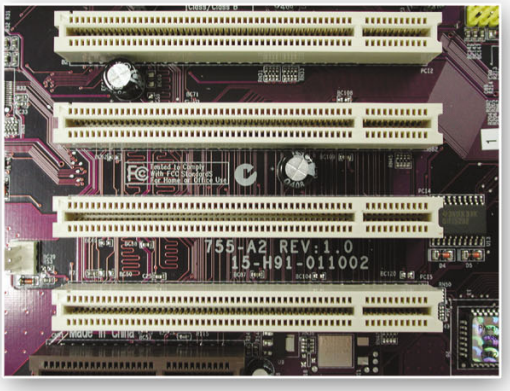
BUS TYPES



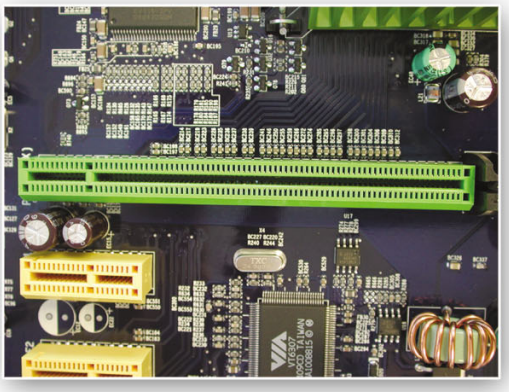
AGP (primarily for graphics cards)



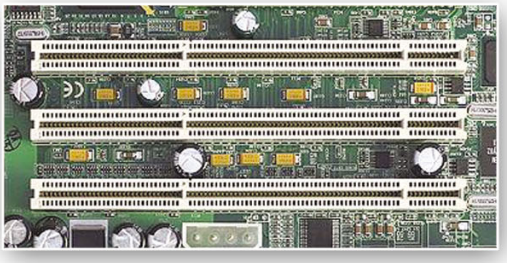
PCI Express x1



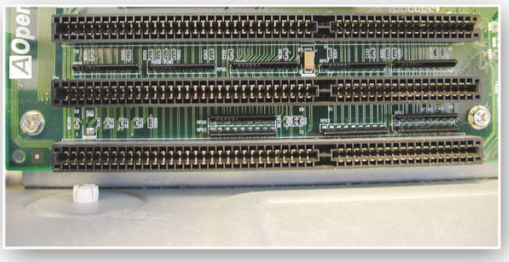
32-bit PCI



PCI Express x16

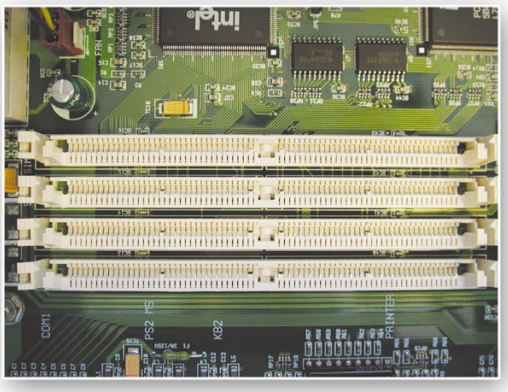


64-bit PCI

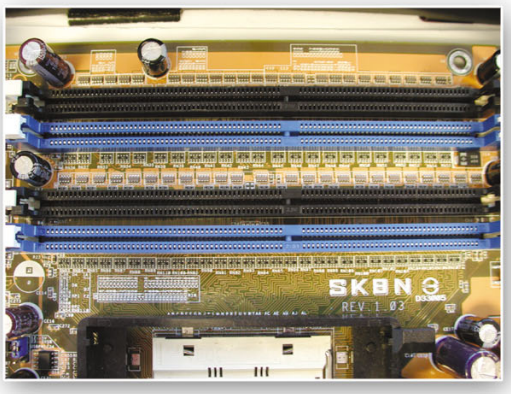


ISA

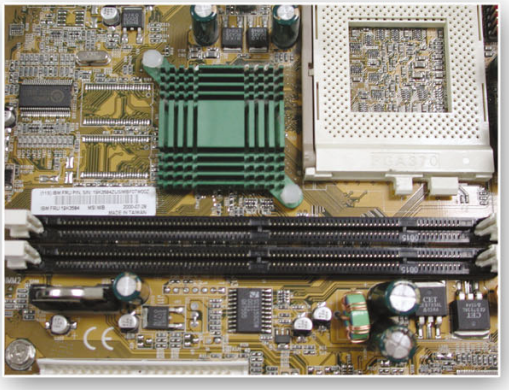
RAM SLOT TYPES



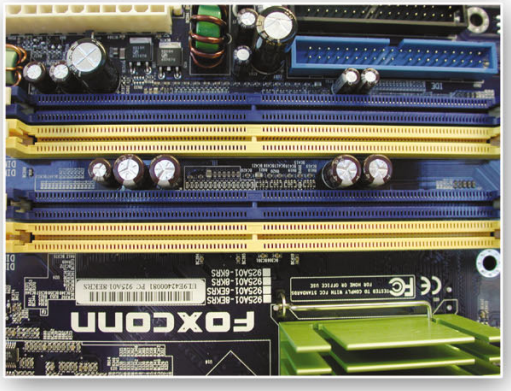
SIMM



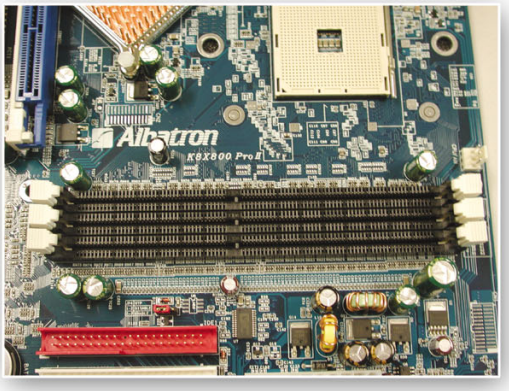
Dual Channel DIMM



SDRAM



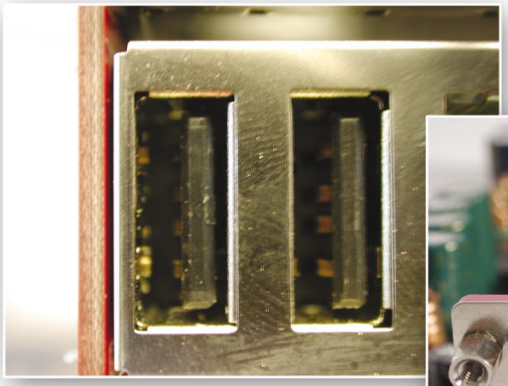
DDR2



DDR

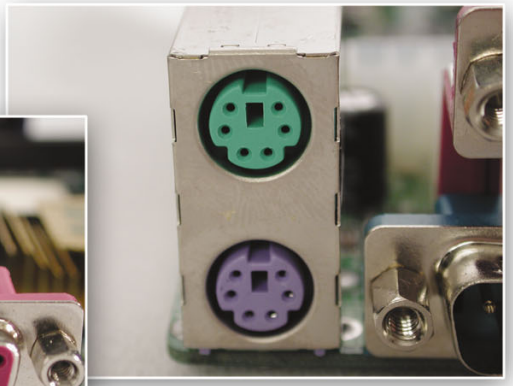
SODIMM

PORT TYPES

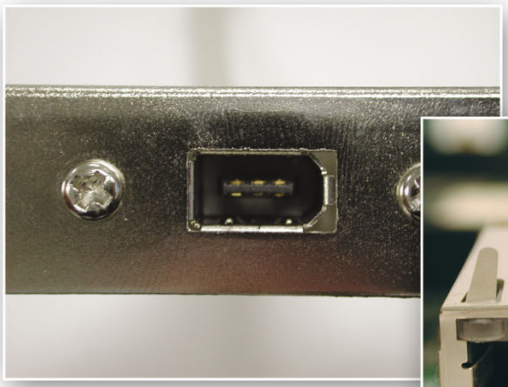


USB

LPT/Parallel

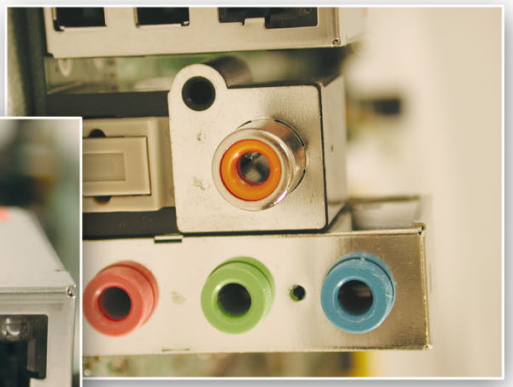


PS/2 Keyboard and Mouse

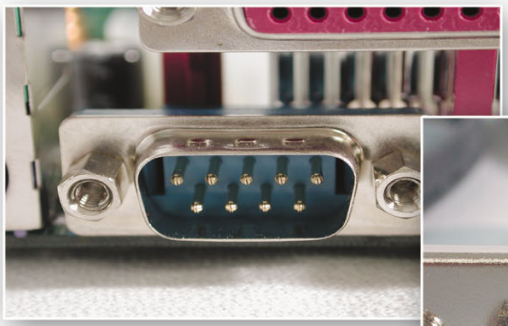


FireWire (IEEE 1394)

Ethernet



Audio



9-pin Serial

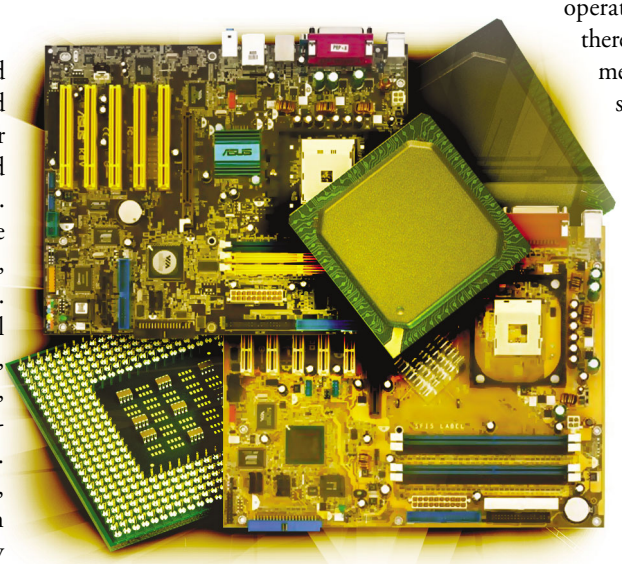
15-pin Serial (Game Devices)

Modem

Tech White Paper:

Hopping On The HyperTransport Bus

An Inside Look At The Backbone Of AMD64



When AMD introduced its Opteron server and workstation processor early in 2000, IT departments around the world sat up and took notice. When it followed through with the Athlon 64 FX a few months later, enthusiasts found cause to celebrate. The vanilla Athlon 64 was also well received by mainstream buyers, who, despite the lack of 64-bit software, enjoyed substantially improved performance in 32-bit applications. Perhaps caught somewhat off guard, Intel wasn't able to counter with faster hardware until later, and by then, AMD had already begun eating away at Intel's loyal enthusiast following.

At least initially, AMD directed most of its marketing energies toward the evangelization of 64-bit processing. However, there was certainly more than 64-bit extensions behind the architecture's success, especially in the realm of multiprocessing. Although the Opteron, Athlon 64 FX, and Athlon 64 all target different markets, their cumulative popularity stems from AMD64, the marketing term encompassing features of the company's eighth-generation microprocessor architecture.

An integrated DDR memory controller is one example. By communicating with system memory directly, AMD64 processors don't suffer the access latency penalties incurred by platforms that employ a northbridge-based memory controller. Large cache repositories also give the newest chips an edge over their Athlon XP and Athlon MP predecessors. There's the obvious inclusion of 64-bit extensions, of course, though most mainstream users are still waiting on Microsoft to finalize Windows XP x64 Edition. And then there's HyperTransport technology, the board-level architecture responsible for enabling communications among all of the connected devices in an AMD64 PC. Its role isn't necessarily the most glamorous in AMD's initiative, but HyperTransport's job is integral, nevertheless.

Wave Goodbye To The Proprietary Bus

It makes sense that a processor manufacturer would tailor a bus technology to address the specific sensitivities of its design. Intel has its AGTL+ (Assisted Gunning Transistor Logic) interface, and Digital Equipment's EV6 bus augmented the Athlon XP. However, those are both proprietary buses, each with inherent disadvantages including the financial burden of licensing fees.

Before AMD64, most board-level designs employed shared, parallel, multidrop buses, not wholly unlike PCI. One or more processors would communicate over the high-speed bus to a northbridge device, which featured its own connections to graphics, memory, and a southbridge that managed I/O. A different, proprietary connection interfaced the two chipset components, allowing the southbridge to operate through the northbridge. Now, there's nothing wrong with that implementation. After all, Intel's Pentium 4 still uses it today. But there's no denying that, especially in multiprocessor environments where two or more processors divide available bus bandwidth, shared buses are getting a little long in the tooth.

The same holds true on the peripheral interconnect side, as well. Emerging PCI Express x16 graphics cards are theoretically capable of pushing 8GBps of bidirectional information. Gigabit Ethernet controllers contribute even more traffic, Serial ATA connectivity is expanding rapidly, and the latest generation of high-definition audio from Intel drives more data than any standard preceding it. Anticipating today's I/O congestion, AMD initiated development of HyperTransport (formerly referred to as Lightning Data Transport) back in 1997. The goal was to develop an architecture that would deliver more bandwidth than existing interconnect solutions, reduce latency (the delay incurred when one system component is waiting on another for information), and lower pin counts, thereby facilitating simplified layout on four-layer motherboard PCBs and reasonable thermal characteristics.

But Why HyperTransport?

HyperTransport technology isn't alone in its quest to squelch the bandwidth problems plaguing today's fastest platforms.

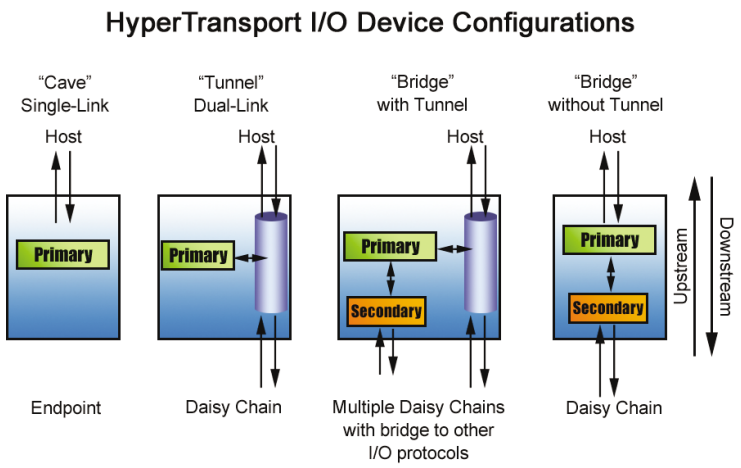
CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

RapidIO and PCI-E purport to address similar concerns, though each has its own set of strengths and weaknesses currently dictating implementation.

For example, RapidIO, originally defined by Motorola and now supported by the RapidIO Trade Association, is available as both parallel and serial specifications. The parallel interconnect utilizes dual-unidirectional links with one clock signal per direction on 8-bit links and two per 16-bit link. It employs packet-based transactions and an LVDS (Low-Voltage Differential Signaling) electrical interface. Unfortunately, although it supports a subset of PCI functionality, RapidIO is not completely compliant with PCI, making it less than ideal for use in an environment rife with PCI devices, such as the PC. RapidIO isn't very flexible, either, supporting bus widths of either 8- or 16-bits. Topping out at 1GHz, that gives the parallel RapidIO spec a peak bandwidth of 8GBps. As a result, RapidIO is well suited for embedded and telecomm applications, where its strengths outweigh weaknesses.

PCI-E is another blossoming interconnect technology already popular on the latest chipsets from Intel. It's serial in nature, but like RapidIO, uses dual bidirectional lanes to connect devices with point-to-point links. Unlike PCI, PCI-E enables dedicated bandwidth through a central switch instead of dividing available throughput across connected devices. Because it's a serial interface, though, including all clock, command, status, data, and address information on a single signal line, PCI-E introduces latency that makes it ideal primarily for board-to-board connectivity. Current PCI-E devices boast a 2.5Gbps transmission rate, although the actual data transfer rate drops to 2Gbps when you factor out overhead imposed by the encoded clock signal. For all of its advantages in speed and flexibility, PCI-E's latency issues generally preclude it from linking multiple processors or other timing-sensitive devices.

HyperTransport was designed with chip-to-chip, inside-the-box communication in mind, an audience it shares with parallel RapidIO. It should come as no surprise, then, that HyperTransport is another point-to-point topology, circumventing the disadvantages of PCI's shared, multiplexed topology entirely. And, like PCI-E, HyperTransport offers full PCI compatibility. For all intents and purposes, HyperTransport technology is in use today, together with the AMD64 initiative, because it's the only existing solution capable of replacing proprietary chip-to-chip interfaces in the context of your PC.

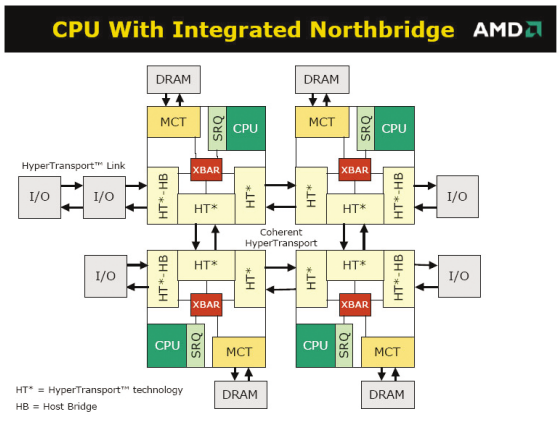


Devices in a HyperTransport link are arranged in a daisy chain that begins with a host, ends with what's called a cave, and may contain bridges and tunnels in between for interfacing with other bus technologies.

Inside HyperTransport

HyperTransport technology can be likened to PCI because it is a parallel bus, but the similarities stop there. Whereas PCI tops out at 66MHz, yielding up to 528MBps of throughput on a 64-bit bus, the latest HyperTransport specification supports signaling up 1.4GHz DDR for 22.4-GBps on a 32-bit bus. Of course, both interconnects are scalable and generally used in slower variations. Most PCI devices are actually 33MHz on 32-bit buses, for instance. Each HyperTransport data path (remember, there are two per link—one input and one output) may be 2-, 4-, 8-, 16-, or 32-bits wide.

The PCI bus has seen a couple of extensions to accommodate higher-end devices, including PCI-X 1.0 and 2.0, the latter offering frequencies of up to 533MHz. Hardware centering on those later revisions is usually only seen in servers and workstations due to the cost and complexity of implementation, though. In sharp contrast, HyperTransport technology is able to realize significantly higher operating frequencies by employing an enhanced, low-swing, 1.2V LVDS signaling scheme instead of the



HyperTransport's point-to-point topology addresses the shortcoming of existing shared, proprietary buses. It alleviates throughput bottlenecks that occur anywhere there's intensive I/O, including multiprocessor environments and among chipset components. (Illustration courtesy of AMD.)

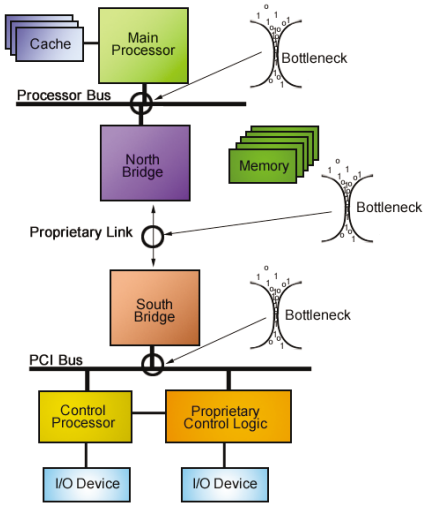
single-wire, single-ended signal. The twin wire lines carry signals that are equal in amplitude and timing but opposite in polarity, resulting in less line noise and a cleaner signal. According to the HyperTransport Consortium, each LVDS line can be up to 24 inches long, which makes it easier to design and manufacture motherboards that employ the technology.

One of the inherent problems with PCI's shared bus approach is that attached devices must arbitrate for control, and only one can transfer over the bus at a time. HyperTransport eliminates that problem with its point-to-point topology. However, because each HyperTransport device communicates over dual, unidirectional data links, components in a HyperTransport link are arranged in a daisy-chain topology consisting of a host device, ending with a cave, and often including tunnels and bridges in between. Tunnels connect the link to another HyperTransport device, while bridges interface with non-HyperTransport interconnects, such as PCI-E, AGP, or PCI-X.

All of the data that traverses a HyperTransport link is bundled into packets for efficient transfer. Command information travels over the data path in 4- or 8-byte packets. The data packet itself consists of an 8- or 12-byte header and up to 64 bytes of payload. For every 8-bit data path, there's also one clock line. A separate control line determines the type of packets a link is carrying. So, if a peripheral device is transferring a particularly long data packet to the host and a second device is waiting on critical information, it can embed an 8-byte control packet into the first transfer and the host will initiate a second transfer to the idle peripheral even as the first transfer continues. This feature, called PRI (Priority Request Interleaving), contributes to HyperTransport's low-latency approach.

Playing Nice With AMD64

AMD's Opteron processor features three 16-bit HyperTransport links running at 800MHz each, for 3.2GBps of bandwidth in each direction. Depending on the number of processors in a given server or workstation, the links serve different purposes. The Opteron 100 series only supports single-processor configurations, so all of the HyperTransport links are noncoherent. A dual-processor Opteron 200-series setup requires one coherent HyperTransport link for enabling communication between the two chips, while an 800-series Opteron employs two coherent links. Because the Athlon 64 FX and Athlon 64 processors don't support multiprocessing, they come equipped with a single noncoherent HyperTransport link for interfacing with a complementary chipset.



AMD's "glueless" multiprocessing relies on HyperTransport to connect processors, memory, and I/O. The result is impressive scaling characteristics through aggregated bandwidth and simplified motherboard designs.

Naturally, HyperTransport shines especially brightly in Opteron systems with multiple processors. Each processing core is able to communicate with the others without having to divide bandwidth among them—already an improvement over Intel's shared processor bus architecture. Furthermore, each Opteron chip has its own 128-bit integrated DDR memory controller that accepts up to DDR400 modules. Coherent HyperTransport links allow one processor to access information in a neighboring processor's memory, aggregating bandwidth. A four-way Opteron machine resultantly boasts 25.6GBps of memory bandwidth among its processors, demonstrating excellent scaling characteristics in the process.

A number of advancements in core logic, most notably the inclusion of PCI-E x16 graphics, have prompted AMD to bolster the bandwidth of its HyperTransport interface, at least on high-end Socket 939 Athlon 64 FX and Athlon 64 processors. Instead of pushing 6.4GBps of bandwidth over an 800MHz link, the latest revision yields 8GBps over a 1GHz bus. Interestingly, PCI-E x16 alone is capable of saturating that connection with 8GBps of theoretical throughput, though there still aren't any applications capable of pushing PCI-E's limits. Even still, the 25% improvement better equips AMD's Athlon 64 family to keep up with upcoming chipsets from NVIDIA and VIA, both of which enable a slew of new features.

In Retrospect

HyperTransport technology addresses the shortcomings of shared, multiplexed bus topologies, such as PCI. It successfully maintains compatibility with PCI devices currently in use, it's economical to implement, and it enables an integral interconnect backbone previously unavailable through proprietary bus solutions.

The advantages that HyperTransport introduces specifically to the AMD64 architecture are equally significant. To begin, it serves as a high-speed chip-to-chip interface, eliminating the conventional northbridge/southbridge structure, and simultaneously enables scalable bandwidth across a range of chipset components. Point-to-point links make it possible to deliver full bandwidth using HyperTransport, while the technology's parallel control signals minimize latency compared to serial I/O initiatives. Scalability in multiprocessing is just icing on AMD's cake.

Recent improvements to the technology are now being reflected in Socket 939 Athlon processors, which feature 1GHz HyperTransport links. The extra bandwidth isn't being utilized yet, but upcoming PCI-E chipsets promise to put it to good use. And there's still plenty of room in the HyperTransport 2.0 specification should additional throughput prove necessary. CPU

by Chris Angelini

Tech White Paper:

PCI Technologies

Aging Bus Technology Still Has Plenty Of Life Yet

The majority of computer components and technologies have undergone radical transformations as they have matured. However, the PCI bus has remained relatively unchanged in its basic functionality since Intel first introduced it in 1992 in an effort to standardize interconnecting chips on motherboards. PCI's longevity has been attributed to the mere fact that it works and should continue to do so in the near future.

However, due to the exponential growth of bandwidth in the last several years, newer PCI technologies have been built on the backbone of the conventional PCI bus technologies. These include PCI-X, PCI Express, low profile PCI, and mini-PCI.

In this white paper, we will examine the history of PCI technologies, how they work, their assorted flavors, and how they differ from one another.

Bus History

Prior to the introduction of the PCI bus in the early '90s, expansion slots on motherboards supported ISA, EISA, VESA local bus, and Microchannel technologies. What this meant was that when users purchased a new machine, more often than not plug-in cards wouldn't transfer from one PC to the next. PCI was designed to alleviate this issue. ISA, EISA, and Microchannel were all replaced by PCI. VESA local bus—a video card slot—was first replaced by PCI and later AGP.

Surprisingly, most PCs today still pass data through the same I/O system as early systems such as the 486—peripherals, hard drives, sound cards, USB, and FireWire all cross a 33MHz PCI bus transferring data at 133MBps. As the need for increased performance has grown, newer technologies such as DDR memory and the AGP bus were introduced to circumvent the limitations of PCI.

Flavors Of PCI

Conventional PCI. PCI was the technology that led to true plug-and-play functionality. The bus standard was a 5V, 32-bit parallel shared-bus technology, meaning it is interrupt-driven and the processor is invoked for all data transfers on the bus. As bandwidth increases, all data transfers compete for access, thus slowing the CPU's performance with interruptions by multiple PCI devices.

The PCI bus was first to introduce full service bus mastering, which allows the devices on the PCI bus to take control of the bus and directly perform I/O. This meant multiple devices on the bus could operate simultaneously using arbitration circuitry to ensure one device couldn't lock out another device on the bus. Alternatively, bus mastering also gives any device full access to the bus if no other device requests I/O. Think of the PCI bus as an internal network that allows multiple devices in a single PC to talk to each other using a communication channel managed by the chipset.

The I/O Bridge or southbridge is the communication channel through which the processor communicates with PCI devices in addition to drive controllers, serial, parallel, game, keyboard, and USB ports. Theoretically, this bridge speed is clocked at 133MBps for I/O. However, data transfer is parallel, which throttles the speed because no data has priority over any other and blocks of data must be sent singularly instead of concurrently. That means I/O moves from one section of the motherboard to the next section only in the order it was received and not based upon importance.

Will PCI Express Replace AGP?

High-performance graphics chips broke away from PCI when AGP was introduced in 1997. Before AGP, the early PCI technologies were inundated with video traffic that competed for the same I/O bandwidth on the bus with other peripheral and hard drive data. To overcome these limitations for better video performance, Intel developed the AGP, which created a dedicated interface between the processor and the video chipset. Once the video card was removed from the PCI bus, less competition for bandwidth increased the overall system performance. Because AGP only interfaces with the processor and the video card, it really isn't considered a bus, but a port.

At 32 bits, the AGP slot is physically similar to the PCI slot in both shape and size, but motherboard manufacturers offset it farther from the edge of the board than the PCI slots. In fact, AGP is based upon the PCI 2.1 specification for 66MHz. The main difference is instead of running at half of the bus speed, it runs at full bus speed, which instantly doubles the bandwidth of the port.

However, with all the performance advantages and comparable speeds, it won't be long until PCI-E takes over AGP 8X. Most graphics chip manufacturers are already using PCI-E in their current GPU's design phase. PCI-E connectors for AGP replacement slots will be 16X, delivering 5GBps. ▲

Not to be confused with the limitations of data transmissions mentioned earlier, PCI supports Burst Mode where after an initial address is presented, multiple sets of data can be passed in a row.

PCI bus speeds operate both synchronously or asynchronously, depending on the chipset and motherboard. The PCI bus runs at half the memory bus speed in a synchronous mode. This means with a memory bus of 50, 60, or 66MHz, the PCI bus would function at 25, 30, or 33MHz, respectively. Synchronous PCI lets you overclock peripherals in association with the chipset; however, this frequently leads to system instability.

In an asynchronous mode, users can set the speed of the PCI bus separately from the memory bus by using mobo jumpers or the BIOS.

Version 2.1 introduced universal PCI cards with 64-bit slots and a 66MHz capacity. It was also able to support both 3.3V as well as 5V. When version 2.3 was adopted, 5V-only adapters were no longer supported; however, all 3.3V universal products were still fully supported. This meant that both types of 32-bit PCI boards could be used in 64-bit slots.

Since its debut in 1992, PCI has evolved to increase speeds up to five times faster than the original specification. After 10 years as the de facto standard, conventional PCI finally hit the wall; enter the PCI-X specification.

PCI-X. As high-end data networking and storage network applications began demanding more bandwidth and speed, the next generation of PCI technology emerged. PCI-X 1.0 was based upon the existing PCI architecture. It provided two speeds—66MHZ and 133MHz; nevertheless, the slowest board continued to dictate the maximum speed on the bus. This new technology offered 64-bit slots with support for universal PCI and 3.3V, but not 5V-only boards—similar to the 2.3 conventional PCI specification. 1.0 was entirely backward-compatible and allowed conventional 33/66MHz adapters to work in PCI-X slots. Additionally, the designers also allowed PCI-X adapters to function in a conventional bus.

Building on version 1.0, the 2.0 specification maintained full backward compatibility using the same form factor, pin-outs, connector, bus widths, and protocols. This version doubled and then quadrupled bandwidth. ECC (Error Correction Codes) was added as a mechanism to improve data integrity offering full RAS support. Since speed and bandwidth were the name of the game, PCI-X 2.0 added two additional speeds—266MHz and 533MHz. This version also offered bandwidth ample enough to support emerging technologies such as fiber channel/10GB Ethernet and 4X/12X InfiniBand.

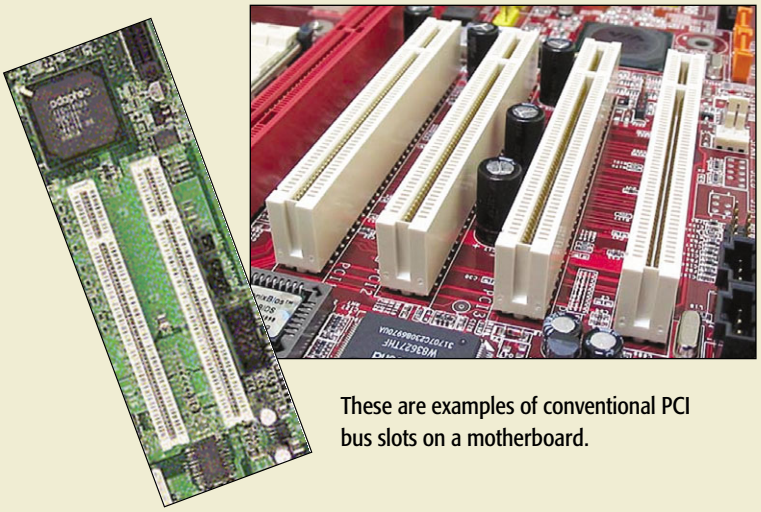
PCI Timeline

PCI specifications have been developed by the PCI Special Interest Group (PCI-SIG) formed in 1992. PCI-SIG has over 900 members that include industry leaders such as Intel, HP, Texas Instruments, IBM, AMD, Dell and Microsoft. The group's purpose is to promote PCI as an industry-wide standard. They maintain full ownership and management of all PCI specification, as well as maintaining forward-compatibility of all PCI revisions.

- **1991** Conventional PCI 1.0
- **1993** Conventional PCI 2.0
- **1995** Conventional PCI 2.1
- **1998** Conventional PCI 2.3
- **1999** Mini-PCI & PCI-X 1.0
- **2000** Low-profile PCI
- **2002** PCI-X 2.0 & PCI Express (formerly known as 3GIO)
- **2004** PCI-X 3.0

Physical Differences

To the trained eye, telling the differences between the three major PCI categories–conventional, PCI-X, and PCI Express–is easy.



These are examples of conventional PCI bus slots on a motherboard.

PCI-X 2.0 also defined a new 16-bit interface width for applications with space constraints, such as embedded RAID controllers, or portable applications. Another new feature expanded the device configuration space for individual device functions and brought a new Device ID Message transaction for simplified peer-to-peer transactions for applications such as streaming media.

However, both versions had speed limitations. Higher speeds (133/266/533MHz) are only supported by point-to-point loads. Multidrop loads, meaning that there are one or more devices between the card and the PCI-X bridge to the memory controller, are reduced to 100MHz for two devices and 66MHz for four devices.

PCI-X 3.0 is currently in development and nearing its release as an available specification. It will have backward compatibility with the previous versions while offering 8.5GBps bandwidths with a 1066MHz data rate. The next step for PCI-X will be the 2133MHz specification, which should take PCI-X technologies well into the next decade.

PCI Express. PCI Express emerged approximately the same time as PCI-X 2.0. Similar to PCI-X, it was a high-speed point-to-point architecture with a serial bus instead of a parallel bus. Data is transmitted in a packetized and layered protocol, similar to Ethernet. This flavor of PCI was designed specifically for dual chip communication, USB 2.0/IEEE 1349b interconnects, and high-speed graphics.

There are currently six forms of PCI Express: x1, x2, x4, x8, x12, and x16. Each lane consists of 4 pins; x1 has one lane, x2 has two lanes, x4 has four lanes, and so forth. The PCI Express data transmission rate is 100MBps per pin. An x1 link consists of four wires-two signal pairs, one for each direction. Likewise, an x16 link would have 64 (4x16 signal pairs) wires. The slots are attached to a switch with the ability to regulate the data flow. This design is a step up over the shared bus architecture because each device gets direct access to the bus instead of multiple devices sharing the bus. Each device, thus, has access to full bandwidth capabilities without having to contend for the maximum bandwidth offered by a single shared bus. Down the road, x32 and possibly x64 slots will be added to PCI Express, extending the shelf life of the technology.

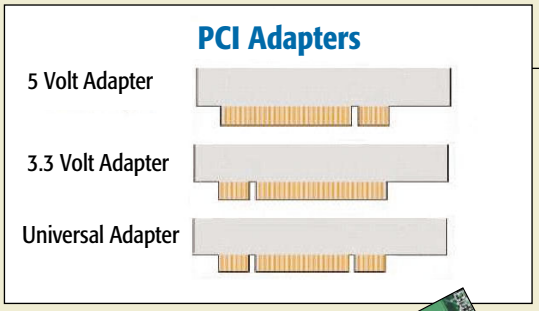
PCI Express will start filtering into the desktop computer market as an addition to conventional PCI slots on motherboards. An additional x16 slot for graphics cards is intended to replace AGP. Still, other mobo manufacturers are planning to equip their products with two x1 slots: one physical slot and the second as a native Gigabit Ethernet controller.

PCI Express is software compatible with PCI 2.3 devices. The specifications provide additional space placed at the end of a standard PCI slot to support lower bandwidth (one- to two-lane) PCI Express devices. Again, this forethought in design has led to better compatibility and extends the technology's lifecycle. With support from leaders such as AMD, ATI, and NVIDIA, PCI Express will set a new standard in I/O technology that should have the endurance of its predecessors.

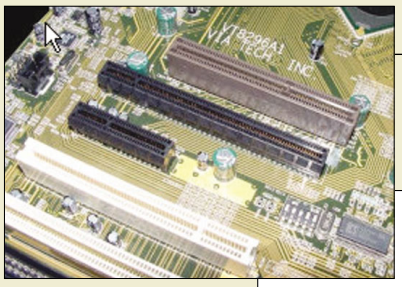
Small Form Factors

As electronic computing devices have shrunk in size, so has the PCI form factor to meet the demands of space-constrained designs. Two different PCI form factors have risen out of these needs: low-profile PCI and mini-PCI. Each fills a specific need in its respective market.

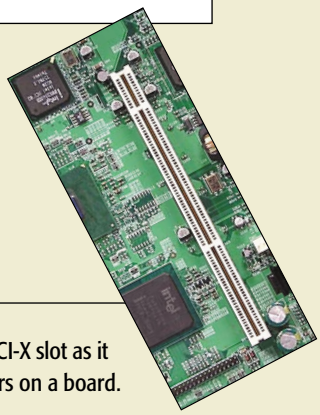
Low-profile PCI is very similar to the conventional PCI v2.2. It uses the same



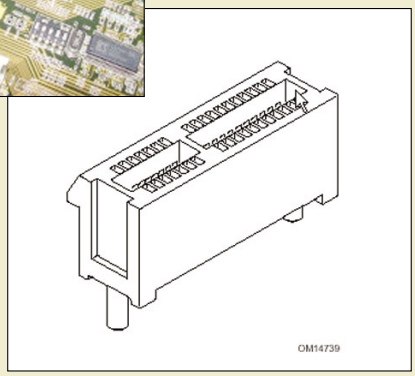
Conventional PCI cards can be distinguished according to their voltages—5V, 3.3V and the Universal.



Here are examples of a PCI Express slot. (TECHNICAL DRAWING COURTESY OF PCI-SIG.)



Here's a PCI-X slot as it appears on a board.



software drivers, computer signals, protocols, and electrical properties. This is not an entirely new specification but an ECN (engineering change of notice) to the conventional PCI specification that adds a new form factor defining a shorter raw card and new mounting bracket. Currently low-profile PCI is backward-compatible for existing brackets. The ECN also stipulates a new bracket design that will no longer support conventional PCI cards. This new form factor's goal is to alleviate the use for riser cards and provide new designs for both desktops and servers.

Compared to conventional PCI adapter cards, low-profile PCI cards can fit into spaces as small as 85mm. There are two different card lengths for 32-bit cards—MD1 and MD2—which set size limits for designers. The shorter of the two is MD1; however, motherboard makers are implementing both sizes in their systems to provide more flexibility.

Mini-PCI is a different initiative than the low-profile PCI. Developed for native communications devices such as network interface cards and modems, mini-PCI is targeted at the OEM market for mobile devices such as printers, docking stations, and portable PCs. Compared to low-profile PCI, the components of mini-PCI are more compact. Additionally, mini-PCI uses a different interface on the motherboard and within the system. Functionally equivalent to a conventional PCI card, mini-PCI card dimensions can go as small as 2.75 x 1.81 x 0.22 inches.

A Long Life Ahead

The development community has set excellent standards that have helped PCI bus technology progress since its introduction in 1992. This is obvious from the longevity of existing PCI technologies and the availability of backward compatibility throughout the advancing specifications. Additionally, designers are continually looking ahead as they expand the capabilities of currently available PCI flavors. Forethought such as that should allow the PCI bus to remain an industry standard well into the next decade. CPU

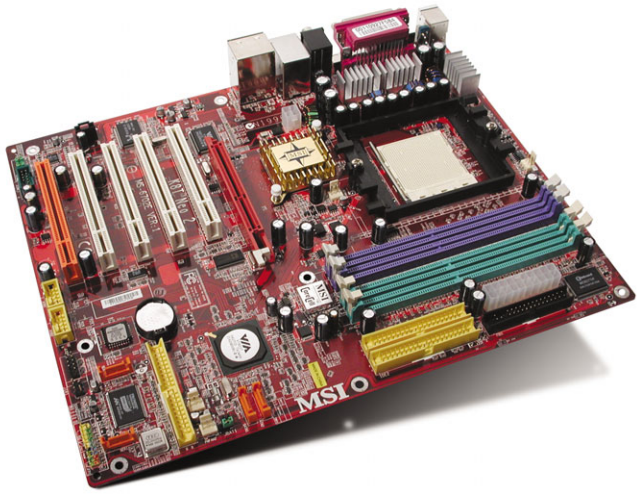
by Sandra Kay Miller

MOBO MANIA

All The Info You Need To Pick Your Next Board

If you've been online shopping for motherboards lately, you know that there are hundreds of choices out there. But which is going to be the best one for the system you're building? Should you go with the new Intel 915 chipset, or is an NVIDIA nForce3 more your speed? Luckily, we can provide some answers. We took 29 leading boards with various socket types and examined their feature sets and BIOSes. We ran them through their paces on several tests with multiple CPUs and then collected all the benchmarks. We even overclocked them until they screamed for mercy. Finally, we reviewed all our data and gave each board an overall rating based on a scale of 0 to 5 CPUs, from absolutely worthless (0 CPUs) to absolutely perfect (5 CPUs). Read on, and find the best board for you. *(NOTE: For more of the latest cutting-edge LGA775 and socket 939 boards, see our roundups on pages 121 and 127. We also look at a handful of mini-ITX boards on page 133.)* CPU

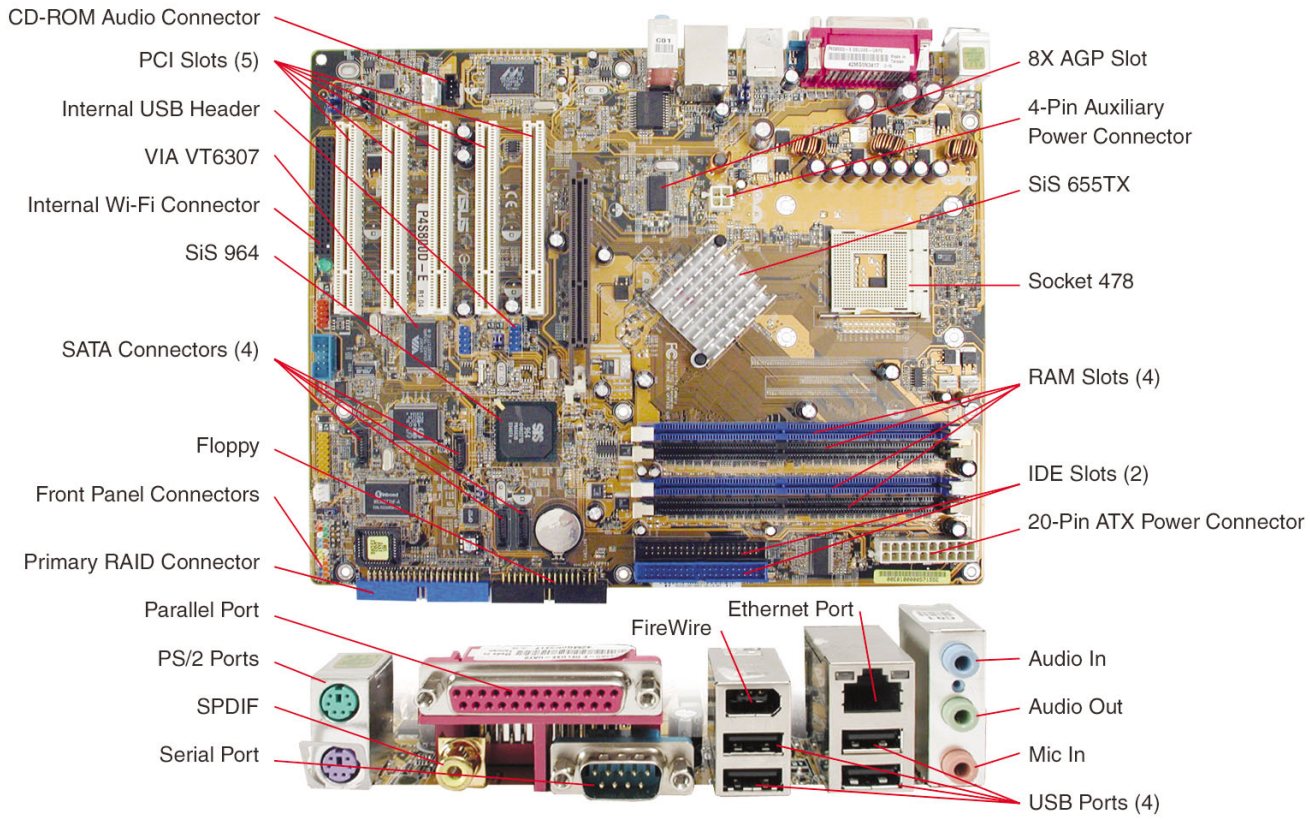
Socket Type	Page
Socket 478	31-54
LGA 775	55-63
Socket A	64-75
Socket 754	76-93
Socket 939/940	94-117



Abit VT7

Layout: ATX (Socket 478)

Chipset: VIA PT880



Not all VIA chipsets—not even those with similar model numbers—work the same, and there's proof in the tests that we performed on Abit's VT7 and SOYO's SY-P4VTP. One motherboard uses VIA's PT800 chipset, the other went for the PT880, and al-though these chipsets have similar drivers, the end results you'll see are nothing alike. First up, the Abit VT7, which integrates the PT880 chipset onto a board that has a surprisingly complete spec list for a product in this price range.

First Impressions

The VT7 is one of Abit's budget-priced motherboards, but at first glance, you could easily mistake this product for a model that costs twice as much. That's because, looks-wise, this is an impressive board.

Abit used a rust-colored PCB that stands out compared to the typical green, black, or gray that most mobos use for a foundation. Our eyes were also drawn to the alternating purple and teal color scheme of the RAM slots. But from an aesthetics point of view, there's no doubt that the northbridge heatsink, which was constructed to look like the company name, is an eye-catching feature that will look exceptionally nice through a large case window.

Looks aside, there are some other notable aspects of the VT7's layout worth mentioning. The 20-pin power connector is a few inches lower than on most ATX boards. That's not a huge inconvenience, but it does mean that cables will necessarily dangle lower into your case and probably have more contact with your hot RAM modules.

The IDE ports line up just below the power connector, and instead of facing upward to receive a hard drive or optical drive plug, they're oriented toward the back of the board. We didn't experience any cable problems due to this configuration, but we're uncertain that it really offers any real benefit, either—unless you're exceptionally talented at keeping cables uncluttered and out of the way.

We're used to seeing budget-priced mobos with only one fan header. However, Abit was nice enough to include not two, not three, but four fan headers so you can

get more air flowing without occupying one of your PSU's power plugs.

In addition, the board contains two bracketless internal USB headers and a standard range of front-panel connectors. We didn't mind the placement of the front panel connectors, but Abit could've more clearly labeled these headers, or better yet, used color-coded plastic bases.

The port section on the rear of the motherboard has a standard range of capabilities. It includes input and output via SPDIF, dedicated audio jacks (onboard audio works via 5.1-channel Realtek technology), and four USB 2.0 ports. There's also a standard 10/100Mb Ethernet port. Enthusiasts will immediately notice that there's no VGA port on this board, meaning you'll have no choice but to employ the services of a third-party video card in the AGP slot.

In the box. Abit didn't include very many extras to go along with the VT7. As with all mobos, you get floppy drive and IDE cables, and you receive a single SATA data cable and a SATA power splitter, too. There's a detailed manual that will assist you with installation and configuration, and there are plenty of screen shots that illustrate BIOS procedures. If you have trouble making any wiring connections, the diagrams and clear instructions will help you tie up any loose ends in just a few minutes.

Performance

The VT7's PT880 chipset isn't as powerful as those found on more expensive boards, but because Abit typically produces good products, we were certain that this model would have at least adequate performance. As it turned out, the VT7's capabilities were more than we could've hoped for.

We constructed a basic system that included an ASUS DVD-ROM drive, 7,200rpm Western Digital SATA hard drive, and 1GB OCZ EL Dual Channel Series Gold Edition DDR PC-4400. We also inserted a Gainward NVIDIA GeForce FX 5900XT 8X AGP video card. To get an idea of how this mobo's performance would change when using a range of CPUs, we used a 2.4GHz Pentium 4 and quickly worked upward, using a 3.2GHz Pentium 4 and then a 3.4GHz Pentium 4 Extreme Edition.

We began testing with our 2.4GHz Pentium 4 CPU. This processor has a 512MB cache and runs at 800MHz FSB.

To get a feel for our system's basic graphics processing capabilities, we started by loading 3DMark 2003. The first score, weighing in at 5186, was quite good. Then we switched to PCMark 2004 to get a better idea of how our setup would handle regular processing tasks. The overall system score was 3806, with a CPU score of 3614.

Of course, benchmarking numbers don't always mean a whole lot, so we also used gaming software to see how well our system would handle other graphics-intensive tasks. We put our board through the paces with Microsoft Halo's demo mode. We ran this test three times, once at a resolution of 800 x 600, then at 1,024 x 768, and then 1,280 x 1,024.

The 2.4GHz CPU zipped through the lowest resolution at 39.93fps, hit a sweet spot in the second highest resolution (42.14fps), and then slowed down to 38.61fps when we used the top resolution. With Halo out of the way, we changed to a newer game, Doom 3, but we used the same resolution settings. Our CPU did its best work at the lowest resolution, logging a rate of 29.1fps, and slowed dramatically (15.1fps) when we cranked the settings all the way up.

As expected, our 3.2GHz CPU produced dramatically faster performance. At stock settings the new chip scored 400 more points in 3DMark. Its PCMark performance, at 4891 points, was nearly 1,100 points higher than the 2.4GHz P4. Surprisingly, the faster CPU didn't produce significantly better results during the Halo demo (until we overclocked it, at least), but at lower resolutions it was almost 10fps faster than the 2.4GHz CPU.

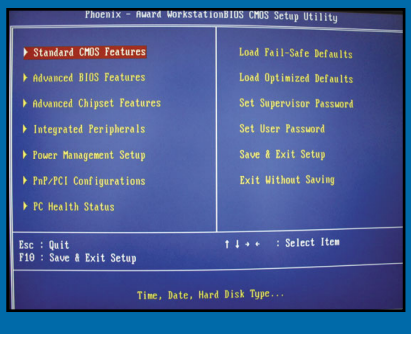
The initial results we saw from the 3.4GHz CPU made us wonder if we had hit a wall of sorts in regards to the VT7's capabilities. At default settings this CPU produced a 3DMark score that was nearly identical to the 3.2GHz processor.

After we ran PCMark, though, we decided that our fears were unfounded. The overall suite score was more than 300 points higher than with the 3.2GHz chip, with the most notable improvements occurring in the CPU score.

Then we ran this CPU through the Halo demo at 800 x 600. This resulted in a 4fps improvement, but unfortunately, those results didn't translate into better numbers at higher resolutions; they were nearly the same as with the slower CPU.

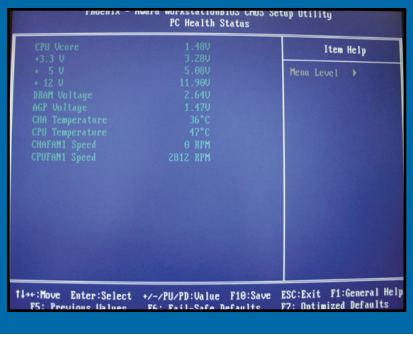
System Specs	
Component	**Model**
Motherboard	Abit VT7
Processor	2.4GHz Pentium 4
Processor	3.2GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	ASUS 16X DVD-ROM Drive
Chassis	Antec Solution Series Mid-Tower Case
Operating System	Windows XP Home

Abit VT7	
Socket Type	Socket 478
Chipset	VIA PT880
Processor Support	Pentium 4 (800MHz, 533MHz, and 400MHz, for Northwood only)
RAM Support	Dual Channel 4GB DDR400/333/266
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	2
USB Ports	4 (8 Total)
FireWire Ports	None
LAN	10/100Mb Operation support ACPI & Wake-on-LAN
Integrated Audio	Onboard 6-channel AC '97 Codec
Integrated Graphics	None
Other Features	Hardware monitoring for fan speeds, voltages, system environment temperature
Manufacturer	Abit
Phone	(510) 623-0500
URL	www.abit-usa.com
Price	$59



The Phoenix-Award BIOS menu lists a standard range of system options.

The PC Health Status screen lets you monitor voltage, temperature, and fan speeds.



Overclocking results. Standard-speed results are one thing; however, we wanted to push the VT7 and see just how high we could boost our benchmark scores. That meant accessing the overclocking features in the VT7's BIOS menu.

Tweaking the CPU speed using the VT7 was exceptionally easy. It was a simple matter of jumping the CPU FSB Clock (MHz) option up a few notches, testing for stability, and then making the setup go a little faster until instability became a problem.

Initially, we increased this option by 30. This turned out to be too fast, and we encountered corrupted operating system files. After patching up our broken Windows, we aimed lower and were rewarded with a more stable setup. In the end, we found only modest gains in CPU speed, at 2.56GHz, which was certainly enough to increase our benchmark scores.

We pushed the 2.4GHz CPU far enough to raise our 3DMark score more than 200 points, and our overall PCMark score received a similar jolt. Those improvements didn't make much of a difference during the Halo demo, but Doom 3 worked much more quickly, especially at lower resolutions.

Our 3.2MHz CPU didn't have as much room for overclocking, but we did make this chip run stable at 3.39GHz. As a result, our 3DMark score barely budged. PCMark offered a little more hope, though, when the suite score increased by more than 200 points, but our pseudo-gaming sessions didn't improve much. In fact, some of our game demo speeds were slower than they were prior to overclocking.

We wrapped up our tests by overclocking the 3.4GHz CPU, which we got to run smoothly at 3.62GHz.

The 3.4GHz processor improved significantly in some areas, but the 3DMark score, as we expected, was raised by fewer than 100 points. However, the processor's overall PCMark score increased by more than 300 points, proving that our system benefited from a speed boost. Unfortunately, our Halo and Doom 3 demos didn't appreciate our efforts, and the fps ratings stayed nearly the same.

Other options. If you so choose, the VT7 will let you tweak other settings in the BIOS to achieve different results. This BIOS has an option to change the AGP/PCI Ratio, one of the latest features added to VIA's chipsets. You can choose the automatic function or lock the divider numbers at an ideal level.

You can also change CPU and DRAM voltages. Abit lets you change CPU voltage from 0.09 to 1.85V in 0.025V increments, which will give hardcore users plenty of slack to find the perfect power settings for various CPUs. And though the DRAM voltage setting won't go as high as many other boards, you can still increase this option to 2.9V for improved performance.

Performance Comparison

Benchmark	2.4GHz Pentium 4	3.2GHz Pentium 4	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.62GHz)
3DMark03				
Build 340	**5186**	**5569**	**5583**	**5664**
PCMark04 1.2.0	**3806**	**4891**	**5207**	**5588**
CPU	3614	4908	5117	5531
Memory	3787	4792	4837	5225
Graphics	4441	4629	4517	4635
HDD	4547	4615	4629	4623
Halo				
800 x 600	39.93fps	43.83fps	47.06fps	48.37fps
1,024 x 768	42.14fps	42.87fps	43.30fps	42.87fps
1,280 x 1,024	38.61fps	30.26fps	30.95fps	30.67fps
Doom 3				
800 x 600	29.1fps	39.0fps	37.6fps	39.3fps
1,024 x 768	22.1fps	26.6fps	27.2fps	27.3fps
1,280 x 1,024	15.1fps	18.0fps	17.9fps	17.7fps

The Verdict

Our overall impression of this motherboard was a very good one. We didn't experience any major technical problems during setup or use, the board has slick looks that will appeal to aesthetics-minded modders, and best of all, Abit kept the price very low. The VT7 is a golden buy for do-it-yourselfers who need to control their system costs. CPU

Overall Rating: CPU CPU CPU CPU

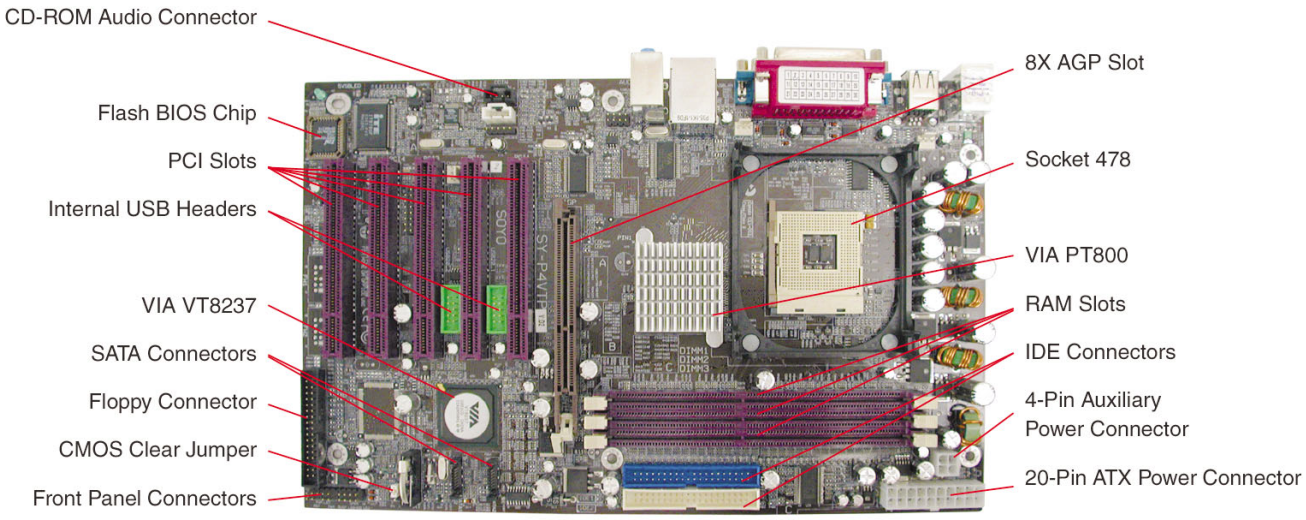
by Nathan Chandler

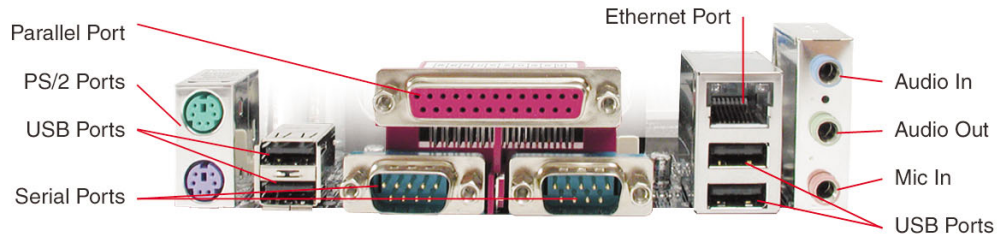
CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

SOYO SY-P4VTP

Layout: ATX (Socket 478)

Chipset: VIA PT800





In this issue we tested two very similar VIA chipsets, the PT880 and the PT800, and we found that a single digit in a chipset's name can make a world of difference when it comes to performance. In the previous article, we put Abit's VT7 through our series of rigorous tests to see how well its P880 chipset would handle the heat. In this story, you'll see just how well SOYO's SY-P4VTP—and VIA's PT800 chipset—handled the same kind of stressors.

A Simple Design

Though it does adhere to the standard ATX form factor, this SOYO motherboard has a much slimmer profile than most similarly priced products. It measures 12 inches from top to bottom, but it's only 9 inches wide, and in a midtower case that will leave a lot of open real estate to the right of the board. If you tend to pack a lot of extra components into your cases, a smaller board such as this might be a welcome addition.

SOYO did an excellent job with regards to some aspects of the SY-P4VTP's layout. The 4-pin and 20-pin power connectors are side-by-side on the top right corner of the motherboard, meaning you can easily connect your PSU's power plugs and tie the slack up into a neat bundle where it won't cause any clutter whatsoever.

You might be aggravated by SOYO's decision to place the floppy drive connector at the very bottom of the board, just to the right of the last PCI card slot. As you can imagine, you'll need a much longer than usual cable to reach around various components.

In part because of this board's overall small stature, there are a lot of components near the CPU, which means that some bulky heatsinks or waterblocks are unlikely to fit without an obstruction causing problems. Capacitors fill much of the space to the top of the socket, the RAM sockets snuggle up against the right side, and the northbridge heatsink, although less than an inch tall, is very close to the socket's bottom side.

There's also precious little space between the three RAM sockets. After we inserted our OCZ RAM modules,

which come with heavy-duty heat spreaders, there was only a millimeter or so between the metal surfaces. That doesn't bode well for users who want to keep each crucial component as cool as possible; short of mounting a fan that blows vertically through these gaps, those modules will simply have to operate at very warm temperatures.

SOYO included two internal USB 2.0 headers on this motherboard. These bracketed headers are tucked between two PCI card slots, and depending on your tastes, this is either a nice space-saving move or a complete pain in the neck, especially if you use PCI cards with a lot of bulky components. Another downside—there's no support for FireWire whatsoever.

The little extras. SOYO didn't throw a lot of extras in with this particular motherboard. Instead, you receive only the most basic components to help you get up and running.

That means the box includes a quick start guide that has basic specs, diagrams, and fundamental software instructions, as well as a CD containing drivers and the complete motherboard manual. There is also a small bag with a floppy drive and IDE data cable, but you won't find a SATA drive data cable or power splitter.

Performance

Intel's chipsets are tough competition for the likes of third-party manufacturers such as VIA, especially because Intel has the luxury of designing its own CPUs. But VIA must be doing something right, because its PT800 chipset competes admirably with those from Intel.

VIA chose to implement some interesting features into the PT800, and it opted to omit certain capabilities, too. One advantage is that this chipset offers 800MHz FSB support. It also works with CPUs using slower 533MHz and 400MHz FSB speeds.

However, instead of embracing dual-channel memory support, the PT800 uses only single-channel RAM. Instead, VIA integrates FastStream64 technology that's supposed to reduce memory controller idle time, and as a result, make up for some of the limitations of using the single-channel setup.

Initial testing. To put our SOYO mobo to the test, we constructed a computer that included a Western Digital SATA hard drive, 1GB OCZ EL Dual Channel Series Gold Edition DDR PC-4400, and an ASUS DVD-ROM drive. We also installed a Gainward NVIDIA GeForce FX 5900XT 8X AGP video card. Instead of using just a single CPU for our tests, we tried four, including a 2.4GHz Pentium 4, 2.8GHz Pentium 4, 3.2E GHz Pentium 4, and a 3.4GHz Pentium 4 Extreme Edition.

For starters, we dropped the 2.4GHz Pentium into the socket and fired up our system using default settings. We ran each test in 3DMark03 and saw a final score of 4505 points.

Our final PCMark04 score was 3048, and it was anchored by a CPU score of 3196. That score was significantly lower than with the Abit VT7, which registered a CPU score of 3614. The memory score (2746) was much, much lower than with our Abit PT880 chipset, a fact that opened our eyes to just how different these two chipsets really are.

Those comparisons remained consistent when we switched to our game tests. For this segment of our experiments, we used the demo modes in Doom 3 and Microsoft's Halo.

For each game, we ran the demo three times, once at a resolution of 800 x 600, then 1,024 x 768, and finally at 1,280 x 1,024.

At the lowest testing resolution, the SOYO motherboard generated a score that was about 5fps slower than the Abit. The gap widened to a surprising 10fps at 1,024 x 768 and grew larger still (about 12fps) when we pushed the resolution to its highest testing setting.

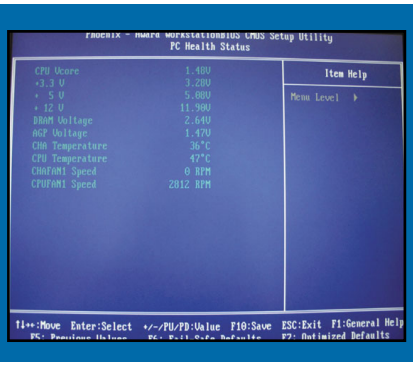
The results we recorded using our 2.8GHz processor were even more telling. Our scores improved, but they were actually lower than the Abit board paired with the 2.4GHz CPU. For example, our 2.8GHz SOYO 3DMark score was only 4456, but the Abit board and slower CPU hit 5186. The SOYO'S PCMark score was 300 points lower, too.

We saw only modest improvement in our 3DMark score when we swapped our 3.2GHz processor for the 2.8GHz CPU. Our final score was 4595, only about 100 points higher than with the slower processor.

However, our PCMark scores certainly looked better. The overall score improved by about 800 points, but the CPU score

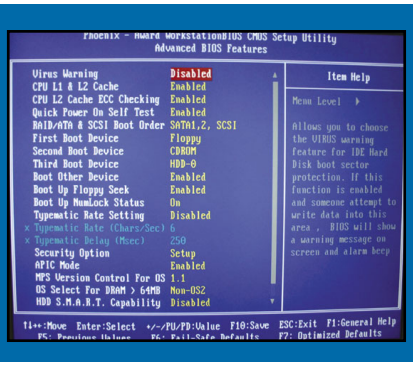
SOYO SY-P4VTP	
Socket Type	Socket 478
Chipset	VIA PT800
Processor Support	Pentium 4 with or without Hyperthreading, Northwood, Prescott (400/533/800MHz FSB), Pentium 4 Celeron
RAM Support	Dual Channel 4GB DDR400/333/266
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	2
USB Ports	4 (8 Total)
FireWire Ports	None
LAN	10/100Mb supports Wake-on-LAN, ACPI
Integrated Audio	Onboard 6-Channel AC '97 CODEC
Integrated Graphics	None
Other Features	Supports onboard Hardware Monitoring and includes Hardware Health Utility
Manufacturer	SOYO
Phone	(909) 292-2500
URL	www.soyousa.com
Price	$90

System Specs	
Component	**Model**
Motherboard	SOYO SY-P4VTP
Processor	2.4GHz Pentium 4
Processor	3.2E GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	ASUS 16X DVD-ROM Drive
Chassis	Antec Solution Series Mid-Tower Case
Operating System	Windows XP Home



Using the PC Health Status screen lets you track fan rpms, view CPU temperature, and more.

The Advanced BIOS Features menu lets you change boot order, alter CPU settings, and modify other crucial options, such as APIC mode.


Advanced BIOS Features
Virus Warning Disabled
CPU L1 & L2 Cache Enabled
CPU L2 Cache ECC Checking Enabled
Quick Power On Self Test Enabled
RAID/ATA & SCSI Boot Order SATA1,2, SCSI
First Boot Device Floppy
Second Boot Device CDROM
Third Boot Device HDD-0
Boot Other Device Enabled
Boot Up Floppy Seek Enabled
Boot Up NumLock Status On
Typematic Rate Setting Disabled
Security Option Setup
APIC Mode Enabled
MPS Version Control For OS 1.1
OS Select For DRAM > 64MB Non-OS2
HDD S.M.A.R.T. Capability Disabled
Item Help
F1:General Help
F2: Optimized Defaults

was more than 1,000 points higher than with the 2.8GHz CPU, a fact that also helped to boost the RAM score by almost 400 points. As expected, the individually recorded hard drive and graphics scores remained fairly static.

The 3.2GHz CPU resulted in faster frame rates during our Halo and Doom 3 tests. When we set Halo's resolution to 800 x 600, frame rates were about 5fps faster than with the 2.8GHz CPU. At a resolution 1,024 x 768, the improvement was less significant; at our highest testing setting, the faster chip didn't really look much faster at all.

Of course, we wanted to overclock each CPU to see how long the motherboard would remain stable. This wasn't to be. SOYO didn't include any comprehensive overclocking tools for this motherboard—in fact, there are no options to change the CPU speed at all— meaning we had to settle for the scores we saw at default speeds.

Overclocking. Because we were disappointed at not being able to overclock the SOYO mobo, we decided to take another route to round out the overclocking portion of this story. We knew that this particular SOYO board was meant to use a Socket 478 CPU with a maximum speed of 3.2GHz. But once we realized that we couldn't use the BIOS to push each processor as far as it would go, we figured we'd try the hardware route instead. That's why we went ahead and installed our 3.4GHz Pentium 4 Extreme Edition CPU.

Our computer booted properly with this CPU in place. We didn't notice any stability problems, so we started our benchmarking routine to see if our motherboard would act strangely with a too-fast CPU in its socket.

We found that the 3.4GHz CPU did improve our overall system performance. It added about 70 points to our 3DMark score. Not a huge increase, but still substantial enough to notice. Our PCMark scores improved in some areas and decreased in others. The overall suite score improved by about 40 points, and unfortunately, the CPU score actually dropped by more than 100 points.

Performance Comparison

Benchmark	Pentium 4 2.4GHz	Pentium 4 2.8GHz	3.2E GHz Pentium 4	3.4GHz P4 Extreme Edition
3DMark03 Build 340	4505	4456	4595	4661
PCMark04 1.2.0	3048	3529	4293	4333
CPU	3196	3741	4755	4629
Memory	2746	2960	3339	3601
Graphics	3758	3720	3824	3862
HDD	4583	4592	4537	4608
Halo				
800 x 600	34.20fps	36.67fps	41.17fps	43.19fps
1,024 x 768	32.91fps	34.36fps	36.96fps	38.13fps
1,280 x 1,024	25.96fps	26.18fps	26.31fps	26.58fps
Doom 3				
800 x 600	32.5fps	28.7fps	29.7fps	29.7fps
1,024 x 768	21.1fps	21.5fps	21.9fps	21.4fps
1,280 x 1,024	15.0fps	14.9fps	15.1fps	15.3fps

Then again, the graphics, memory, and hard drive scores all climbed higher. The improvements within the graphics and hard drive areas were minimal. However, our RAM score broke the 3600 mark, which was significantly better than with the 3.2GHz CPU.

Our retesting process proved to us that this processor was running without any major glitches and that we didn't cause any noticeable damage to the chip or the board. Unfortunately, even stretching the hardware restrictions of this mobo didn't create benchmark numbers to really sell us on the idea of buying one.

SOYO-nara

It's obvious that SOYO didn't create this motherboard for the overclocking crowd. There are very few options to increase your system's performance, and even at stock settings, the board didn't wow us with any impressive benchmark numbers. If anything, our experiences with the SOYO mobo taught us the importance of investigating each chipset before you buy, because the difference in performance and overall value from various products can have a huge impact on computing sessions.

We obviously don't recommend this particular board to overclockers, and we don't think average home users should spend their money on this mobo, either. There are plenty of other products in a similar price range (and lower price range) with more features and better speed. You'll want to invest in this motherboard model only if you find it for a very low price ($50 or less) online. CPU

Overall Rating: CPU CPU CPU

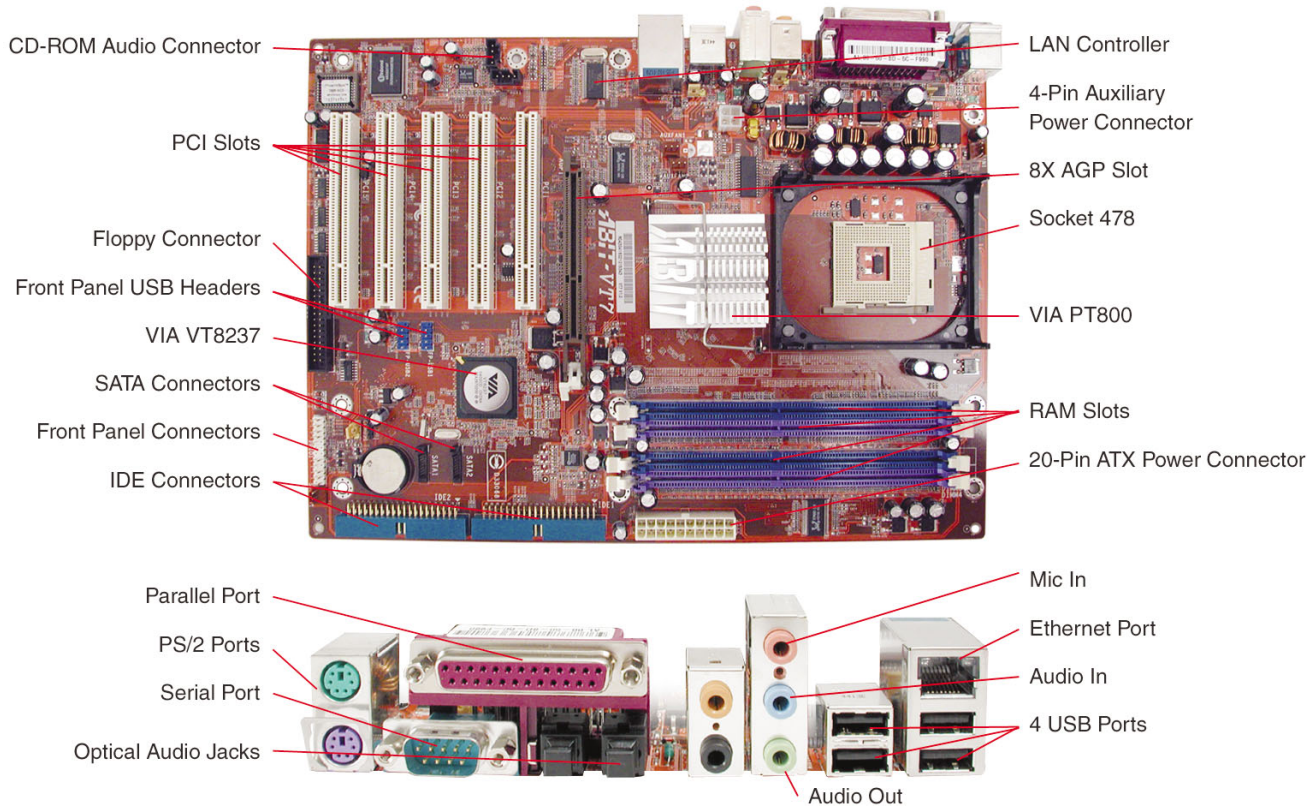
by Nathan Chandler

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

ASUS P4S800D-E Deluxe

Layout: ATX (Socket 478)

Chipset: SiS 655TX



ASUS doesn't mess around when it comes to challenging Intel and other heavyweight motherboard makers. With its P4S800D-E mobo, ASUS offers a full slate of high-tech capabilities, excellent construction quality, and a lot of lovable extras.

Layout Details

ASUS didn't design this board to appeal to visually oriented modders, so the layout has none of the glitzy details or colors to catch enthusiasts' eyes. Because we like cases with windows, this was a minor drawback for us. However, we found that there were more important comments to offer concerning this motherboard's layout.

The 20-pin power connect is in an ideal spot on the upper-right side of the board. That means your biggest power connector doesn't have to do any stretching or straining whatsoever, and you can tie the bulk of its wires out of the way. Then again, ASUS managed to place the 4-pin power connector in an awkward position. It rests below and left of the CPU socket, meaning this power cable will hang directly over your CPU heatsink fan.

If you look closely, you'll notice one more header tucked away at the very bottom of this board. This is an ASUS Wi-Fi slot that lets you perform an optional wireless LAN upgrade. Some of the company's motherboards actually ship with the antenna and card you need to make this feature work from the get-go; however, this particular model doesn't come with the necessary hardware.

Some users won't like that numerous motherboard components crowd the CPU socket. Seven capacitors line the left side of the socket, and the northbridge heatsink has one corner that nearly touches the plastic socket bracket. It's easy to see this lack of space causing problems if you decided to install a larger heatsink or a watercooling system.

ASUS made it easy for both novice and experienced users to make the proper connections on this motherboard. Connecting the wires for the power and reset switches, as well as status LEDs, is a matter of following the lead of the color-coded headers.

Other essentials. If you get confused during the configuration process, all you have to do is consult one of the many clear diagrams included in the printed users manual. This thick booklet has numerous clearly marked, helpful diagrams of the motherboard itself, and it has many BIOS menus and utility screen shots to help guide you. If you want to jump right into the building process, you can opt for the printed Quick Start guide instead.

You get plenty of tools to help set up your system. The box contains two SATA data cables, a SATA drive power splitter, an UltraDMA cable, IDE cable, floppy drive cable, I/O shield, two-port USB 2.0 cable, and one FireWire cable.

Performance

The SiS 655TX has many of the best features found in Intel's budget chipsets. It supports 800MHz frontside bus CPUs, has AGP 8X compatibility, and works with DDR400 dual-channel RAM, although you can save a few bucks and stick with single-channel memory if you prefer. If you choose to use dual-channel RAM, you will see a peak memory bandwidth of about 6.5GBps.

The SiS 964 southbridge has an accompanying SiS 180 SATA controller chip that drives the four SATA channels, which have RAID capabilities. This chipset has a USB controller that will support up to eight USB ports, and although there's none of the Gigabit Ethernet support you'd see on some Intel mobos, you'll still be able to use the 10/100Mb Ethernet port.

The southbridge also lacks support for FireWire devices. To remedy this situation, ASUS included VIA's VT 6307 controller, which runs the rear-mounted FireWire 400 port and the internal FireWire header, too.

Standard tests. As with all the motherboards in this issue, we put together a standard testing machine to keep our experiments as fair as possible. Our computer included a Western Digital SATA hard drive, an ASUS DVD-ROM drive, and 1GB OCZ EL Dual Channel Series Gold Edition DDR PC-4400. In the AGP slot, we inserted a Gainward NVIDIA GeForce FX 5900XT 8X AGP video card. We installed three CPUs to see how their performance would vary; we included a 2.4GHz Pentium 4, 2.8GHz Pentium 4, and a 3.2E GHz Pentium 4.

We began by installing the 2.4GHz Pentium 4. Then we worked through a range of tests that included 3DMark03, PCMark04, and then the demo modes built into two games, Microsoft's Halo and iD Software's Doom 3.

Our 3DMark score of 4723 was solid, but not as high as we've seen with other mobos. However, the PCMark score (3618) was very good, and the CPU score was one of the best we've seen with this particular CPU.

Switching to a 2.8GHz Pentium 4 noticeably enhanced our system's performance. As with all of the CPUs we tested on this mobo, the 3DMark score barely budged, but our overall PCMark rating changed by more than 400 points, and the CPU and memory scores also shot significantly higher. Unfortunately, the faster CPU didn't have much of an effect on our game demo frames-per-second ratings; these numbers stayed about the same as with the slower CPU.

We would've been remiss if we hadn't pushed our ASUS board with hardware it wasn't intended to use. That said, we installed a 3.2E GHz Pentium 4 just to see if it would work properly. At default speed and voltage settings, we didn't encounter problems while using this CPU, and better yet, we saw quite an increase in our scores compared to the 2.4GHz and 2.8GHz processors.

Overclocking Results

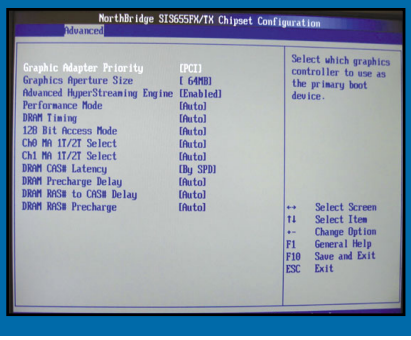
This ASUS motherboard comes with an AI Overclock Tuner feature imbedded in the BIOS menu. Using this tool, overclocking is a matter of selecting a percentage of just how far you want to push your CPU, with the maximum number being 30%, and the smallest number as 5%, all of which provide a significant performance enhancement when they work.

You can forego automatic overclocking and use manual features instead. If you go this route, you can alter options for CPU and DRAM frequency, and you can change options such as CPU VCore Voltage, CPU VCore Offset, AGP VDDQ Voltage, and DDR Reference Voltage. In addition, you can tweak many other settings, such as those for the chipset configuration.

2.4GHz CPU results. We were thoroughly impressed with both our CPU and motherboard when we started overclocking our 2.4GHz Pentium 4. We immediately selected the automatic 30% overclocking

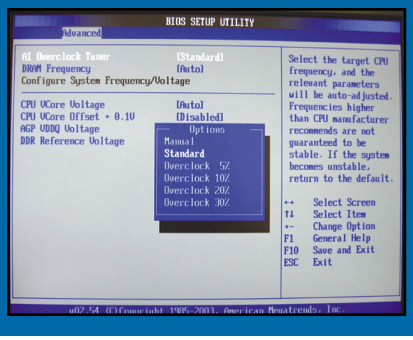
ASUS P4S800D-E Deluxe	
Socket Type	Socket 478
Chipset	SiS 655TX/SiS 964
Processor Support	Pentium 4/Celeron up to 3.06GHz
RAM Support	4GB unbuffered DDR400/333/266/200
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	4
IDE	2
USB Ports	4 (8 Total)
FireWire Ports	VIA VT6307 support 2 connectors (1 Back Panel/ 1 onboard)
LAN	Marvell 1000Mbps Ethernet controller
Integrated Audio	ADI AD1888 SoundMAX 6-channel audio
Integrated Graphics	None
Other Features	1 ASUS proprietary Wi-Fi slot; SiS HyperStreaming Technology
Manufacturer	ASUS
Phone	(502) 995-0883 (tech support)
URL	www.asus.com
Price	$69

System Specs	
Component	**Model**
Motherboard	ASUS P4S800D-E Deluxe
Processor	2.4GHz Pentium 4
Processor	2.8GHz Pentium 4
Processor	3.2E GHz Pentium 4
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	ASUS 16X DVD-ROM Drive
Chassis	Antec Solution Series Mid-Tower Case
Operating System	Windows XP Home


NorthBridge SIS655FX/TX Chipset Configuration
Advanced
Graphic Adapter Priority [PCI]
Graphics Aperture Size [64MB]
Advanced HyperStreaming Engine [Enabled]
Performance Mode [Auto]
DRAM Timing [Auto]
128 Bit Access Mode [Auto]
Ch0 MA 1T/2T Select [Auto]
Ch1 MA 1T/2T Select [Auto]
DRAM CAS# Latency [By SPD]
DRAM Precharge Delay [Auto]
DRAM RAS# to CAS# Delay [Auto]
DRAM RAS# Precharge [Auto]
Select which graphics controller to use as the primary boot device.
↔ Select Screen
↑↓ Select Item
+- Change Option
F1 General Help
F10 Save and Exit
ESC Exit

The BIOS menu contains options that let you change the chipset's configuration.

Using the AI Overclock Tuner, overclocking your CPU is sometimes as easy as selecting a percentage.


BIOS SETUP UTILITY
Advanced
AI Overclock Tuner [Standard]
DRAM Frequency [Auto]
Configure System Frequency/Voltage
CPU VCore Voltage [Auto]
CPU VCore Offset + 0.1V [Disabled]
AGP VDDQ Voltage
DDR Reference Voltage
Options
Manual
Standard
Overclock 5%
Overclock 10%
Overclock 20%
Overclock 30%
Select the target CPU frequency, and the relevant parameters will be auto-adjusted. Frequencies higher than CPU manufacturer recommends are not guaranteed to be stable. If the system becomes unstable, return to the default.
↔ Select Screen
↑↓ Select Item
+- Change Option
F1 General Help
F10 Save and Exit
ESC Exit

option, and to our surprise, the system started up with nary a glitch. Then we checked the CPU speed and found it running at a super-fast 3.12GHz, far faster than we expected.

As you can imagine, this beastly overclock helped our chip crush the scores it logged at default settings. However, our initial 3DMark test actually showed decreased performance. Whereas the default setting gave us a score of 4745, our overclocked chip displayed a significantly lower score of 4444.

Things changed in a hurry after we launched PCMark. Whereas the CPU's default speed yielded an overall score of 3618, the overclock settings gave us a score that was more than 500 points higher. The improved CPU score, though, was even more impressive. At its base setting this processor netted a score of 3691, but with the ASUS board's automatic overclocking feature, that number jumped by 994 points. Our memory score increased by 400 points, too, although the graphics score lost ground.

2.8GHz CPU results. Because of our tremendous success with the 2.4GHz CPU, we expected great results from our 2.8GHz CPU. We tried to use the automatic overclocking option at 30% and 20%, but to no avail. Both times the system refused to boot. At 10%, the system ran smoothly and hit a speed of 3.08GHz.

That number didn't sit well with us. We manually adjusted the voltage and CPU speed numbers in the BIOS, and with just a little work, managed to raise the overclocked speed to 3.28GHz.

Thanks to that speed increase, we managed to raise our PCMark suite score by more than 200 points, to 4287. Our CPU's segmented score went up to more than 4900, an increase of more than 700 points.

Once again, our graphics scores suffered during the overclocking routines. In PCMark, our score dropped by about 300 points, and we saw a similar decrease after 3DMark ran its course.

Our game demos didn't show the same ill effects. Both the Halo and Doom 3 demos displayed FPS ratings that were about the same with default and overclocked CPU speeds.

3.2GHz CPU results. We had only spotty success when we tried to overclock this CPU. At one point we managed to boost the CPU speed to 3.50GHz and run our 3DMark application to completion; this worked correctly only when we significantly increased the CPU voltage. Our efforts didn't yield much in the way of faster performance. In fact, our overclocked CPU actually produced a lower score than when it was running at its base speed.

We tried to run PCMark using the same overclocked settings, but the program repeatedly shut down until we relented and used a much more conservative configuration. Those more gentle overclocking settings gave us a CPU speed of 3.34GHz. Although that wasn't much of a jump in speed, our PCMark scores did rise noticeably, with the overall score improving 200 points.

Performance Comparison

Benchmark	Pentium 4 2.4	Pentium 4 2.8GHz	3.2E GHz Pentium 4	3.2E GHz Pentium 4 Overclock (3.34GHz)
3DMark03 Build 340	4723	4745	4789	4507
PCMark04 1.2.0	3618	4069	4642	4834
CPU	3691	4158	4909	5074
Memory	4077	4381	4967	5171
Graphics	3568	3555	3582	3593
HDD	4636	4608	4639	4608
Halo				
800 x 600	38.69fps	42.28fps	44.55fps	46.49fps
1,024 x 768	35.59fps	37.90fps	38.55fps	40.35fps
1,280 x 1,024	26.22fps	26.57fps	26.54fps	27.2fps
Doom 3				
800 x 600	28.6fps	29.3fps	28.8fps	29.9fps
1,024 x 768	21.4fps	21.1fps	21.9fps	22.fps
1,280 x 1,024	14.8fps	15.2fps	15.3fps	15.1fps

Final Shutdown

Our tests proved to us that this ASUS motherboard is an excellent investment for average home users and an even better value for enthusiasts who do more than their fair share of overclocking. The P4S800D-E Deluxe's wide-ranging list of features and low price make it a suitable foundation for a very fast, very cost-effective system. Whether you want a stable board that runs a CPU at its base settings or a budget-priced overclocking monster, this ASUS mobo is worth a look. CPU

Overall Rating: CPU CPU CPU CPU

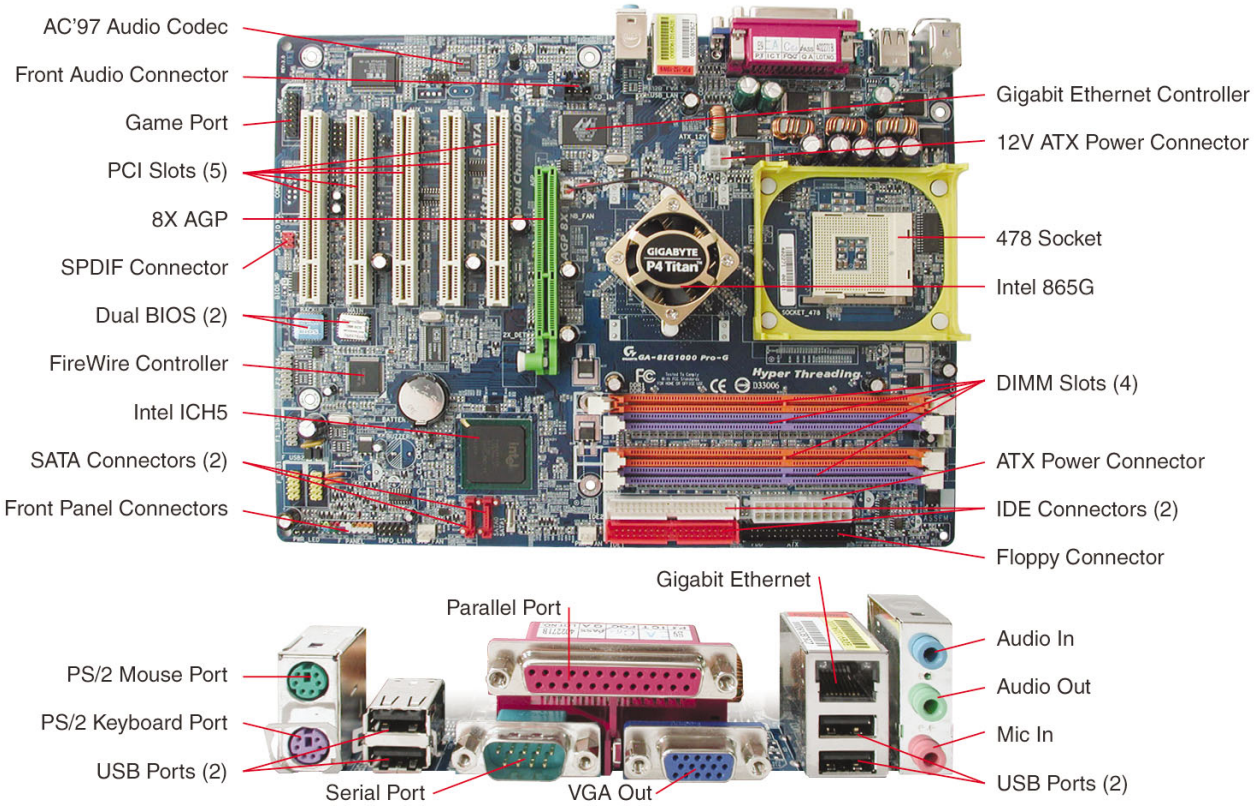
by Nathan Chandler

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

GIGABYTE GA-8IG1000 PRO-G

Layout: ATX (Socket 478)

Chipset: Intel i865G



With the introduction of Intel's 915 and 925 chipsets, the company's older 865 chipset is on the way out. With support for DDR2 and PCI Express, the 915 and 925 chipsets represent the future for computer enthusiasts. That doesn't mean, however, that the day of the 865 is completely over. The 865 has long been a favorite of enthusiasts because it provides excellent performance for relatively little cash. At around $60 for a low-end 865 motherboard, the 865 will continue to be popular with budget-conscious enthusiasts.

GIGABYTE's GA-8IG1000 Pro-G motherboard uses an Intel 865G northbridge coupled with an Intel ICH5 on the southbridge. The motherboard includes integrated graphics, audio, and Gigabit Ethernet, making it a great motherboard for office desktops. Typically, manufacturers don't worry too much about catering to the overclocking crowd on motherboards with integrated graphics, but that's not the case with this board.

Let's Talk About Silicon

Intel's 865G doesn't include support for DDR2 and PCI Express found in the newer 915 chipsets, but it does support frontside bus speeds of 400MHz, 533MHz, and 800MHz. The G indicates that the chipset includes Intel's Extreme Graphics 2 integrated graphics chip. As you'll see when we talk numbers, the integrated graphics are far from stellar, at least from a gaming perspective. If you're looking for this board to anchor a productivity-oriented system, however, the graphics are perfectly serviceable. If you want to beef up your pixel rendering, the motherboard does support 8X AGP. Installing an AGP card disables the onboard graphics.

Intel's ICH5 on the southbridge complements the 865G. The ICH5 provides support for two SATA drives. Considering the $107 price tag, we were a little surprised this board didn't use the ICH5R to provide support for SATA RAID. The board can map a

SATA drive to an IDE channel, so there's no need to install third party SATA drivers when installing Windows XP. This makes installing WinXP easy, especially if you're the type to misplace driver discs.

It's almost impossible to find a motherboard today that doesn't include integrated audio, and most include integrated Ethernet. The GA-8IG1000 Pro-G goes beyond standard 10/100 Ethernet with a Marvell Gigabit Ethernet controller. A Realtek ALC850 audio codec provides 5.1-channel surround sound.

BIOS

Our GA-8IG1000 Pro-G came with the F3 BIOS revision installed. Testing with this BIOS revision proved difficult when overclocking, as PCMark04 failed to provide an overall PCMark04 or CPU score. We also ran into problems with 3DMark03 rebooting our system during the second sound test at higher clock speeds.

We solved our 3DMark03 problem by upgrading our sound drivers and remedied our PCMark04 problems by upgrading our BIOS to the latest F4 revision.

GIGABYTE provides multiple ways to upgrade your BIOS. Its @BIOS software utility lets you easily upgrade your BIOS from Windows. To avoid accidentally downloading the wrong BIOS, the @BIOS utility can download the proper BIOS for you automatically. GIGABYTE also includes a QuickFlash utility that lets you update the BIOS from within the BIOS itself. Both methods are easier than flashing the BIOS from a boot disk.

Manufacturers of 865G boards pay little attention to the overclocking crowd, but GIGABYTE includes enough options on this board to keep tweakers happy.

In the Frequency/Voltage Control section in the Setup Utility, you'll find options to increase the system's FSB. You can lock the speed of your AGP, PCI, and SRC bus to help stabilize the system and even clock your memory settings. In addition, you can increase the processor's core voltage, as well as your AGP and Memory voltages.

Software

The 8IG1000 Pro-G comes with a healthy dose of software utilities. GIGABYTE's EasyTune lets you monitor your system's overall health (including fan speeds and processor temperature).

Performance

As we mentioned earlier, most 865G boards are aimed at the lower end of the market as enthusiasts often aren't fond of integrated graphics. This board, however, sports some hefty features (and a hefty price tag) not normally seen on 865G boards.

For initial testing, we used our Gainward NVIDIA GeForce FX 5900XT 8X AGP graphics card and bypassed the integrated graphics. We tested this board with three different processors: a Celeron D 335 running at 2.8GHz, a 3.2E GHz Pentium 4, and a 3.4GHz Pentium 4 EE.

We started our testing with the Celeron D 335. The Celeron D uses the same Prescott core as our 3.2E GHz Pentium 4. Both processors are made using Intel's 90nm fabrication process and both include 1MB of L2 Cache. The Celeron D, however, runs at a 533MHz frontside bus compared to the Pentium 4's 800MHz FSB.

Our initial 3DMark03 score was a decent 5878. PCMark04 component scores showed strong Graphics and HDD scores (4557 and 4002, respectively) while our CPU and Memory scores remained low (3706 and 3691, respectively). This likely seems to be a result of the slower 533MHz FSB utilized by the Celeron D. Our overall PCMark04 score was 3636, low compared to our Pentium 4 processors but strong compared to scores for our Celeron D running on other motherboards.

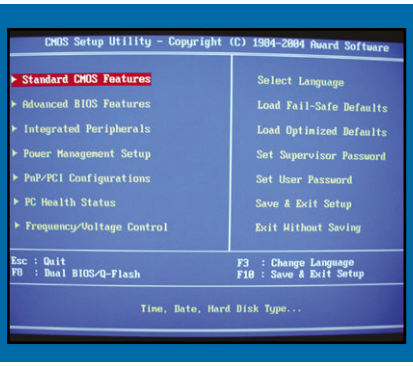
We ran Halo to see what kind of frame rates we could expect. At 800 x 600, we managed 36.28fps. Oddly enough, our frame rates improved to 39.22fps at 1,024 x 768, an occurrence we noted with other processors on this mobo. Moving to 1,280 x 1,024 dropped our frame rates to a still-playable 34.57fps. Doom 3 was a different story. At High Quality we managed a 24.8fps, 19.4fps, and 13.6fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024.

Testing our system with the GeForce FX 5900XT doesn't test the integrated graphics on this board. We removed our NVIDIA card and reran our benchmarks using the default settings for our integrated video.

The results were utterly pathetic and show why enthusiasts generally don't opt for boards with integrated graphics (or at least not Intel's Extreme Graphics 2). 3DMark03 essentially laughed at us when we tried to run it, telling us it

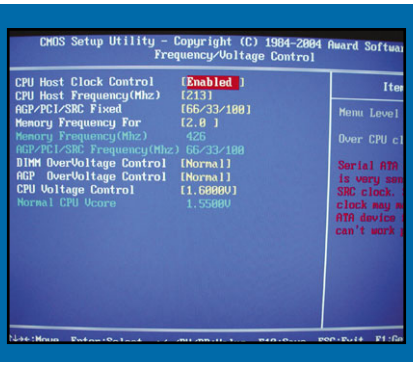
GIGABYTE GA-8IG1000 Pro-G	
Socket Type	Socket 478
Chipset	Intel i865G
Processor Support	Pentium 4 (Williamette, Northwood, and Prescott), Celeron, Celeron D
RAM Support	Dual Channel 4GB DDR400/333/266
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	2
USB Ports	4 (8 Total)
FireWire Ports	3 (1 on included bracket)
LAN	Marvell Gigabit Ethernet Controller
Integrated Audio	Realtek ALC850 Codec
Integrated Graphics	Intel Extreme Graphics 2
Other Features	Norton AV, Personal Firewall, Privacy Control, Parental Control & Spam Alert.
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	www.giga-byte.com
Price	$107

System Specs	
Component	**Model**
Motherboard	GIGABYTE GA-8IG1000 Pro-G
Processor	Celeron D 335 2.8GHz
Processor	3.2E GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home



To access the Quick Flash utility, press F9 from the BIOS main menu.

The Frequency/Voltage Control section of the BIOS lets you tweak your system to improve performance. Adjust the FSB to overclock the processor.



could only perform one of four game tests on our system and politely suggesting 3DMark01 may be better suited to our system. PCMark04 returned an overall score of 3016, a loss of 620 points. The CPU and Memory score decreased slightly to 3694 and 3504, but we saw a massive drop in the Graphics score from 4557 to 563. The HDD score also saw a slight drop to 3989.

Halo scores fell dramatically. We managed just 19.60fps at 800 x 600. By the time we reached 1,280 x 1,024, scores fell to just 11.45fps. To be fair, Halo did warn us the system didn't meet the system requirements, but we opted to continue the test anyway. Not surprisingly, Doom 3 consistently froze during testing.

Replacing our Celeron D with our 3.2E GHz Pentium 4 increased our benchmark scores dramatically. Our 3DMark03 score improved to 6232, and our overall PCMark04 score increased 1184 points to 4820. Leading the way were improvements to our CPU and Memory scores (4610 and 4886, respectively). The added processing power also added another 349 points to our Graphics score, increasing it to 4906.

The extra speed helped make Doom 3 almost playable at 800 x 600 with 26.9fps. Scores fell to 20.1fps and 13.8fps at 1,024 x 768 and 1,280 x 1,024. Once again, our best Halo score (51.30fps) came at 1,024 x 768. We managed a 48.82fps and 42.01fps at 800 x 600 and 1,280 x 1,024.

Scores without our GeForce FX 5900XT, once again, were lower. Our PCMark04 score fell to 3908. Our Graphics score fell to 621. This was still better than the 563-point score posted with the Celeron D but certainly not an acceptable score for gamers. Halo scores fell to 27.74fps, 21.46fps, and 14.39fps.

Finally, we installed the 3.4GHz Pentium 4 Extreme Edition. Our 3DMark03 score showed slight improvement at 6299. PCMark04 scores also improved. Our overall score increased to 5234 based on the significantly higher CPU score that increased 589 points to 5199. Memory and Graphics scores increased to 4935 and 4955, respectively.

The 3.4GHz P4 EE gave us our best Halo scores yet. At 800 x 600, we managed 55.47fps. Scores improved again at 1,024 x 768, yielding 58.17fps. At 1,280 x 1,024, we managed a playable 43.60fps. Doom 3 makes you fight for every 0.1fps. Even with our 3.4GHz P4 EE, we managed just 26.9fps at 800 x 600. Frame rates fell to 20.1fps and 13.8fps at 1,024 x 768 and 1,280 x 1,024.

Removing our video card dropped our overall PCMark04 score significantly to 4164. Our CPU score saw a slight increase to 5227, but our Memory score fell to 4782. Our Graphics score naturally took the biggest hit as it fell to 625. Halo frame rates, of course, also fell. At 800 x 600, the game was ugly but playable at 29.60fps.

With options that cater to overclockers, the GA-8IG1000 Pro-G also overclocks very well. We managed to overclock our 2.8GHz Celeron D 335 to an impressive 3.57GHz. Our 3.2E GHz P4 showed similar improvements, increasing to 3.52GHz. Our 3.4GHz P4 EE didn't show quite as well, only allowing us to push it to 3.62GHz. Interestingly enough, we were able to complete 3DMark03 at 3.77GHz, but PCMark04 froze anytime we tried to move beyond 3.62GHz.

Final Word

Overall, we were impressed with the quality of the GA-8IG1000 Pro-G, although we are hesitant to recommend it. You can get more for your money, and the integrated graphics simply aren't worth it. CPU

Overall Rating: 4 CPUs

by Chad Denton

Performance Comparison

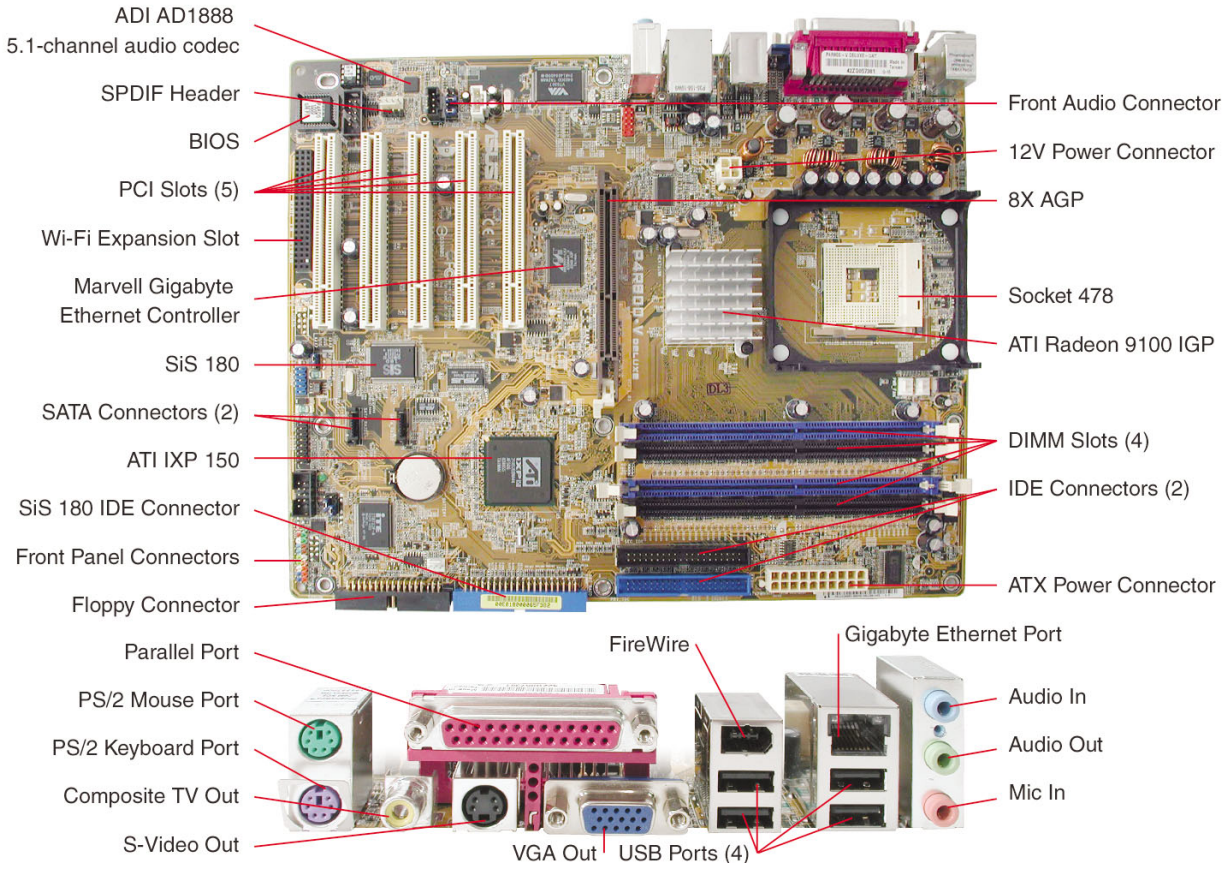
Benchmark	Celeron D 335	3.2E GHz Pentium 4	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme EditionOverclock (3.62GHz)
3DMark03 Build 340	5878	6232	6299	6324
PCMark04 1.2.0	3636	4820	5234	5512
CPU	3706	4610	5199	5483
Memory	3691	4886	4935	5042
Graphics	4557	4906	4955	5019
HDD	4002	4032	3911	3886
Halo				
800 x 600	36.28fps	48.82fps	55.47fps	54.51fps
1,024 x 768	39.22fps	51.30fps	58.17fps	56.74fps
1,280 x 1,024	34.57fps	42.01fps	43.60fps	42.82fps
Doom 3				
800 x 600	24.8fps	26.9fps	26.9fps	27.0fps
1,024 x 768	19.4fps	20.1fps	20.1fps	20.1fps
1,280 x 1,024	13.6fps	13.8fps	13.8fps	13.8fps

CPU Ranking: 0 = Absolutely Worthless, 2.5 = Absolutely Average, 5 = Absolutely Perfect

ASUS P4R800-V Deluxe

Layout: ATX (Socket 478)

Chipset: ATI RADEON 9100 IGP



The ASUS P4R800-V Deluxe features ATI's RADEON 9100 IGP chipset. Considering ATI is known primarily for its graphics processors, it's no surprise that IGP stands for integrated graphics processor. Like the Intel 865G chipset we looked at previously, the Radeon 9100 IGP eliminates the need for a separate video card.

New Chips

Gamers are never going to go for a board with integrated graphics because, in most cases, integrated graphics are stripped-down versions of the graphics processors found on discrete video cards. The Radeon 9100 IGP, for instance, is based on ATI's Radeon 9200 series. Radeon 9200 GPUs feature four pipelines to speed data processing. The Radeon 9100 IGP only includes two pipelines to reduce complexity and cost. As a result, the integrated graphics aren't very impressive.

The Radeon 9100 IGP does everything else you'd expect from a P4 northbridge. The chipset supports dual-channel memory, and its 8X AGP means you can always bypass the integrated graphics. The Radeon 9100 IGP, however, does have one unique feature the 865G is lacking. It's called SurroundView, and it lets you connect up to three displays, two from a compatible ATI video card and one from the motherboard.

The ATI IXP 150 resides on the southbridge. While Intel's ICH5 supports up to eight USB 2.0 ports and SATA, ATI's IXP 150 only supports six USB 2.0 ports and completely lacks any support for SATA. In

order to provide the much-needed SATA support, ASUS uses a SiS 180 controller.

Like the GIGABYTE board we looked at previously, the P4R800-V Deluxe includes a Marvell Gigabyte Ethernet controller. Most Gigabyte solutions pump data from the network to the processor via the PCI bus, limiting the throughput to about 133MHz. The P4R800-V Deluxe includes a dedicated link to the northbridge, bypassing the PCI bus and delivering theoretical speeds up to 266MBps. The ADI AD1888 audio codec provides 5.1-channel surround sound and SPDIF audio outputs.

Plug It In

The P4R800-V Deluxe includes three IDE connectors that can support a total of six drives. In addition to providing SATA support, the SiS 180 controls the lower IDE connector and allows you to create an ATA RAID array by connecting two hard drives to this IDE channel. This might be useful if you're looking to create a RAID 1 (mirroring) array for redundancy purposes.

The back I/O plane on the motherboard features four USB 2.0 ports. A USB header on the motherboard lets you connect two additional USB ports. If you don't have USB ports on your chassis, you can attach the included bracket. A FireWire port is included on the motherboard, and motherboard headers let you wire additional FireWire 400 ports to the motherboard. The motherboard includes S-Video and composite video outputs.

BIOS

The GIGABYTE board we reviewed previously mapped our SATA drive to an IDE channel, letting us install Windows XP without installing third-party drivers. Sadly, the P4R800-V Deluxe lacks this option. Before we could install WinXP, we needed to create a driver disk. The included CD-ROM included a MakeDisk.exe utility.

Our board included a Phoenix BIOS revision 1005. We quickly upgraded to revision 1008 for testing, as this version corrected a problem with Pentium 4 Extreme Edition processors. (Previous revisions didn't detect the 2MB of L3 Cache.) The ASUS LiveUpdate Utility allowed us to quickly and easily update the BIOS.

In the Advanced section of the system BIOS is a Frequency/Voltage Control subsection that's pertinent to overclockers. In this subsection, you can adjust the motherboard's FSB, as well as CPU core, memory, and northbridge voltages. At first glance, it looked like this board offered plenty of options for overclockers, but we were disappointed after getting a closer look. Many of the voltage options simply didn't go high enough to make a real difference. The CPU Core Voltage, for instance, could only be increased by 0.1V regardless of the processor we used.

One option noticeably absent was the ability to lock the AGP and PCI bus. Generally, increasing your FSB speed increases your PCI and AGP clock speeds, as well. This can be beneficial from a pure speed perspective, but it often makes the system unstable. The ability to lock these buses generally allows you to reach higher FSB speeds.

Performance

Overall, the board didn't perform quite as well as the GIGABYTE GA-8IG1000 Pro-G board we reviewed earlier. Nonetheless, the scores were at least competitive and the integrated graphics are much better than Intel's Extreme Graphics 2.

As in our previous review, we started our testing with a Celeron D 335 running at 2.8GHz. The Celeron D runs at a slower 533MHz FSB, so we can expect slower CPU and memory performance compared to a Pentium 4 operating on an 800MHz FSB.

Compared to our last motherboard, 3DMark03 and PCMark04 scores were down a bit. Our 5639 3DMark03 score was down 239 points from our last board. PCMark04 scores were more mixed, but the most notable difference was the 3449 Memory score, which was 242 points lower than the Memory score posted by our GIGABYTE board. The HDD score was also down at 3779. Although the CPU score was virtually identical and the Graphics score was up slightly, the lower Memory scores resulted in a slightly lower overall PCMark04 score of 3643.

Halo scores were also a bit better on the GIGABYTE board. At 800 x 600, we managed 33.04fps on the P4R800-V Deluxe, a difference of 3.24fps. Scores fell to 32.61fps and 28.72fps as we increased the resolution to 1,204 x 768 and 1,280 x 1,024. It wasn't all bad news on the Doom 3 front, however. Our 25.2fps at 800 x 600 beat the 24.8fps posted by the GIGABYTE board. We managed 20.1fps and 14.2fps at 1,024 x 768 and 1,280 x 1, 024.

ASUS P4R800-V Deluxe	
Socket Type	Socket 478
Chipset	ATI Radeon 9100 IGP
Processor Support	Pentium 4 (Williamette, Northwood, and Prescott), Celeron, Celeron D
RAM Support	Dual Channel 4GB DDR266/333; 2GB DDR400)
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	3
USB Ports	6 With Included Bracket
FireWire Ports	1
LAN	Marvell Gigabit Ethernet Controller
Integrated Audio	ADI AD1888 5.1-channel audio codec
Integrated Graphics	Radeon 9200-based integrated graphics
Other Features	ASUS PC Probe, ASUS LiveUpdate Utility, Trend Micro PC-cillin 2002, Intervideo WinDVD Suite
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com
Price	$97

System Specs	
Component	**Model**
Motherboard	ASUS P4R800-V Deluxe
Processor	Celeron D 335 2.8GHz
Processor	3.2E GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

We removed the video card to test the Radeon 9100 IGP and found that it significantly outclassed Intel's Extreme Graphics 2 but still lagged behind our dedicated video card. We were able to run 3DMark03 although our system didn't support the final game (Mother Nature) and thus didn't run. Our 747 3DMark03 was a far cry from the 5639 we scored earlier. Our CPU and HDD scores in PCMark04 remained largely unchanged, but our Graphics score fell from 4590 to 1541. That score, however, was still almost 1000 points better than Intel's Extreme Graphics 2.

Previously, we were able to run Halo but not Doom 3. This time around, Halo wouldn't run without our NVIDIA card, but Doom 3 did. As you would expect, however, scores at High Quality were pretty pathetic. At 800 x 600 we managed just 8.2fps. Scores sunk like a rock after that, falling to 7.1fps and 5.1fps at 1,024 x 768 and 1,280 x 1,024.

We swapped out our Celeron D for a 3.2E GHz Pentium 4. The 3.2E GHz features the same core as the Celeron D but runs at an 800MHz FSB, which should increase our processor and memory performance.

Our 3DMark03 score of 5877 was still well below the 6232 we received with the same processor on our GIGABYTE board. The 4776 overall PCMark04 score was also low compared to our results from the GIGABYTE board. We did receive a faster CPU score (4885), but once again the Memory and HDD score (4488 and 3800) were lacking.

Halo scores were also lower compared to the previous board. We managed 44.13fps at 800 x 600, 43.04fps at 1,024 x 768, and 33.77fps at 1,280 x 1,024. Doom 3 scores, however, once again showed improvement. We managed 27.9fps, 21.0fps, and 14.4fps in Doom 3.

Removing the video card caused scores to tumble. Our 3DMark03 score fell to 790. CPU, Memory, and HDD scores were largely unchanged in PCMark04, but our Graphics score fell from 4913 to 1784, causing our total PCMark04 score to fall more than 400 points to 4343. Doom 3 wouldn't run at 1,280 x 1,024, but we did manage 11.5fps and 8.3fps at 800 x 600 and 1,024 x 768.

Our final processor was a 3.4GHz P4 Extreme Edition. Unlike the previous two processors, the 3.4GHz P4 EE features an older Northwood core. 2MB of L3 Cache help improve this processor's multimedia performance.

Compared to our previous review, our 3DMark03 score was once again significantly lower at 5948 (compared to 6299 in our last review). PCMark04 scores were closer. Our overall score of 5174 was only 60 points lower than our previous score with the same processor. The CPU score was down slightly at 5160 but once again the Memory score was the biggest disappointment at 4524, 411 points lower than our previous review. The HDD score was also a little low.

Once again, we saw our Halo scores suffer a bit on this board. At 800 x 600, we managed just 47.06fps compared to 55.47fps with the same processor in our last review. Scores fell as we increased resolution. At 1,024 x 768 we managed 45.29fps, and we got 34.34fps at 1,280 x 1,024. As we've observed, Doom 3 scores were actually better on this board. We managed 28.0fps at 800 x 600 compared to 26.9fps in our last review. Frame rates remained high as we increased the resolution. We managed 21.0fps and 14.3fps at 1,024 x 768 and 1,280 x 1,024.

Removing our NVIDIA card caused scores to drop sharply. Our 3DMark03 score fell to just 789, which was actually one point lower than the 790 we scored with our 3.2E GHz P4 on this board. In PCMark04, our Graphics score fell most significantly to 1896. Again, this buried the 625 we scored with Intel's 865G.

Given that a few options were missing in the BIOS, we were surprised the board overclocked as well as it did. Check out the chart to see our overclocking results.

Performance Comparison

Benchmark	Celeron D 335	3.2E GHz Pentium 4	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.69GHz)
3DMark03 Build 340	5639	5877	5948	6016
PCMark04 1.2.0	3643	4776	5174	5563
CPU	3704	4885	5160	5581
Memory	3449	4488	4524	4805
Graphics	4590	4875	4928	4977
HDD	3779	3800	3817	3869
Halo				
800 x 600	33.04fps	44.13fps	47.06fps	50.28fps
1,024 x 768	32.61fps	43.04fps	45.29fps	49.48fps
1,280 x 1,024	28.72fps	33.77fps	34.34fps	35.96fps
Doom 3				
800 x 600	25.2fps	27.9fps	28.0fps	28.3fps
1,024 x 768	20.1fps	21.0fps	21.0fps	21.1fps
1,280 x 1,024	14.2fps	14.4fps	14.3fps	14.4fps

Final Word

ATI's 9100 IGP provides consistently lower PCMark04 Memory scores than Intel's 865 and 875 boards. The SiS 180 SATA controller also seems to lag a little behind Intel's ICH5. Most scores from this board lagged behind competitors using Intel's 865 and 875 chipsets.

Despite the performance deficits, however, there's a lot to like about this board. At $97, it's cheaper than our previous board and includes more features. The integrated graphics are also much better.

If you're an overclocker, you may want to hold out for something more suited to your needs. If you're looking for a full-featured 865 clone, however, this is a feature-rich if somewhat unspectacular board. CPU

Overall Rating: 2.5

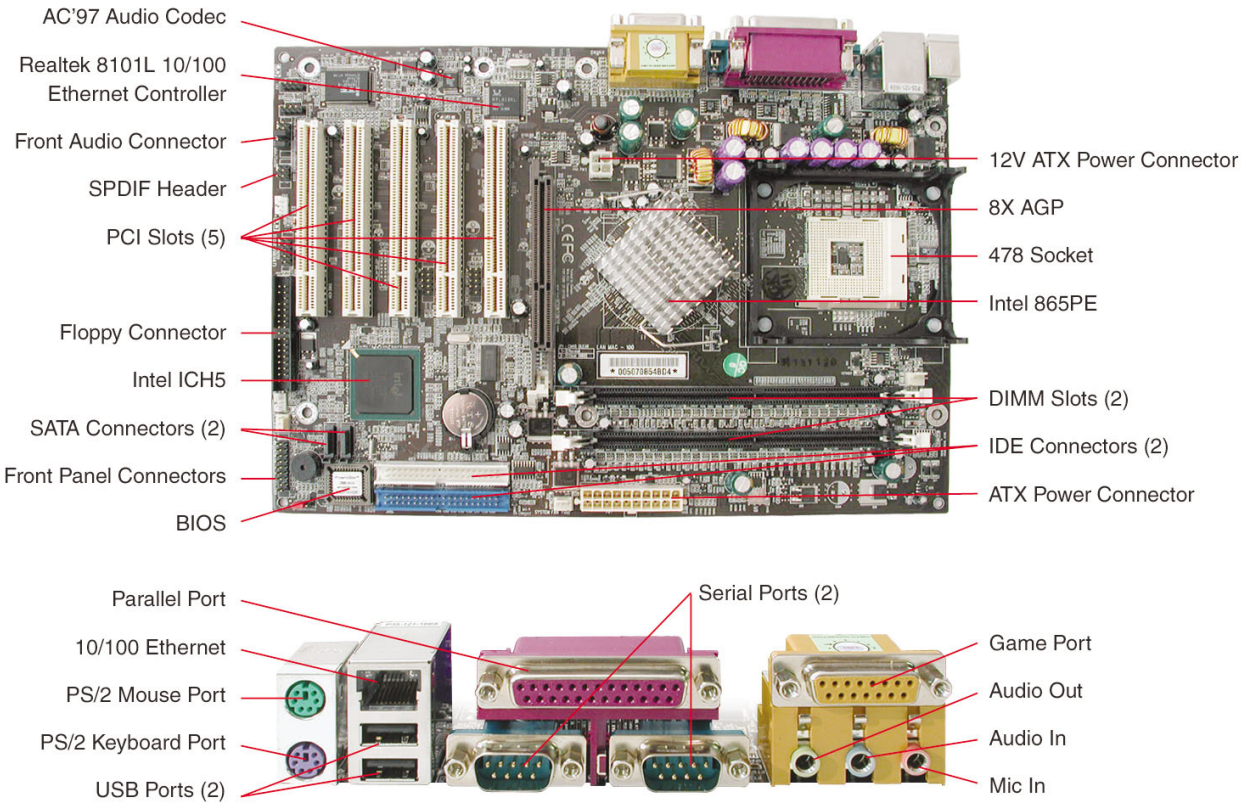
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

CHAINTECH S865PE

Layout: ATX (Socket 478)

Chipset: Intel 865PE



Intel's 865PE has long been a popular choice among computer enthusiasts. Although the 865PE is lacking compared to Intel's new 915P, it is still widely regarded as delivering the best performance for your dollar.

Silicon Roundup

The S865PE lacks some of the features found on more expensive motherboards, but its excellent performance makes it a great choice for users on a tight budget. The 865PE chipset provides support for Pentium 4 processors running on 400MHz, 533MHz, and 800MHz FSB speeds, as well as the latest 8X AGP cards. Unlike the 865G chipset used on the GIGABYTE GA-8IG1000 Pro-G board reviewed earlier, the 865PE doesn't include integrated video, so you'll need to install a separate video card.

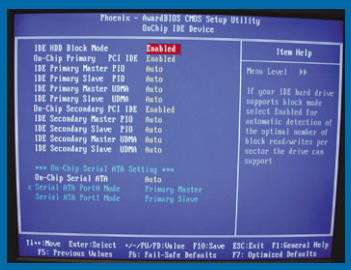
Although the 865PE can support as much as 4GB of DDR SDRAM, the S865PE only supports 2GB of DDR400 dual-channel memory. The 2GB limit won't be a problem for most users, but memory upgrades will require you to replace existing modules, not add new ones.

On the southbridge, the S865PE features an Intel ICH5. The ICH5 provides support for two SATA ports, two UDMA 33/66/100 IDE ports, and eight USB 2.0 ports. The ICH5 doesn't include support for SATA RAID like the ICH5R.

The S865PE does include integrated Ethernet and audio. The Realtek RTL8101L provides 10/100 Ethernet connectivity. You won't find Gigabit Ethernet support on this board. The AC'97 audio codec provides 5.1-channel surround sound. The motherboard does include an optional SPDIF header, but you'll need a separate bracket that's not included with the board. SPDIF delivers 5.1-channel surround directly to a Dolby Digital receiver.

Components & Peripherals

As you can tell, the S865PE provides fairly basic hardware support. You won't even find FireWire support on this board. The back I/O panel includes just two USB 2.0 ports. Three headers on the motherboard let you connect additional USB



In the OnChip IDE Device section of the BIOS, select Auto for On-Chip Serial ATA and you won't need to install third-party drivers when installing Windows XP.

The S865PE has pretty rudimentary overclocking options. Although you can lock the AGP and PCI bus speeds, you can't adjust the processor's core voltage.

ports. Although other boards include brackets with additional USB ports, the S865PE does not. That means you'll need a case with additional USB ports or some sort of front-panel connector with additional USB ports.

A front audio connector is available in case you want to use more conveniently located audio jacks on your chassis. Connecting your chassis to the audio header, however, disables the rear audio jacks.

The back I/O panel includes most of the traditional I/O ports you're used to seeing on a motherboard, including PS/2 ports, a parallel port, two serial ports, and a game port for older, non-USB joysticks and game controllers. Of course, an RJ45 jack is available for Ethernet cabling, and three audio jacks provide Line In, Line Out, and Mic connections. The audio jacks also support 5.1-channel surround-sound speaker systems, but you'll have to do without Line In and Mic jacks when using a 5.1-channel speaker system.

Although not overly impressive in terms of the features it provides, the S865PE does provide solid scores and stable performance for a good price. We've found this board online for just $66.

BIOS

We checked for a BIOS revision before beginning our testing, but the S865PE didn't have any updates available at press time. Luckily for us, the BIOS shipped with the board supports Prescott-based processors.

The BIOS was a little disappointing. In the Frequency/Voltage Control portion of the BIOS, you can adjust the FSB speed and the memory frequency. Unfortunately, the BIOS won't let you increase the processor's core voltage, eliminating a handy way to stabilize your system at higher clock speeds. The BIOS does let you lock down your AGP and PCI bus speeds, which helps maintain a little bit of stability.

The BIOS, however, does map SATA drives to standard IDE channels. This makes installing Windows XP easier, as you don't have to install third-party drivers from the disk.

Software

The S865PE comes with minimal software. The included CD-ROM contains chipset drivers along with audio and Ethernet drivers, but it lacks the kind of bonus software we've come to expect from other manufacturers.

Performance

If the S865PE seems underwhelming so far, it's only because we haven't benchmarked it yet. What the system lacks in features, it makes up for in performance.

As in our previous reviews, we started our testing with a Celeron D 335 running at 2.8GHz. The Celeron D uses Intel's new Prescott core and is similar to Prescott-based Pentium 4s. Both processors feature a 1MB L2 Cache and 90nm design. The Celeron D, however, runs at a much slower 533MHz FSB, as opposed to the Pentium 4's 800MHz FSB.

The S865PE was impressive from the first test, posting the best Celeron D 3DMark03 score thus far. The 5966 score was almost 100 points better than the Celeron D 3DMark03 score posted previously by our GIGABYTE board.

Our S865PE also posted better PCMark04 scores than our two previous boards. The 3815 overall PCMark04 score was 172 points better than the Celeron D score posted by the ASUS P4R800-V Deluxe in our previous review. The 3847 Memory score was more than 150 points

Performance Comparison

Chaintech S865PE

Benchmark	Celeron D 335	3.2E GHz Pentium 4	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.57GHz)
3DMark03 Build 340	**5966**	**6276**	**6347**	**6402**
PCMark04 1.2.0	**3815**	**4996**	**5402**	**5589**
CPU	3742	4981	5160	5580
Memory	3847	5062	5227	5516
Graphics	4702	4888	4991	4988
HDD	3990	3910	3892	3888
Halo				
800 x 600	36.95fps	46.83fps	50.15fps	51.83fps
1,024 x 768	37.58fps	46.34fps	48.38fps	50.51fps
1,280 x 1,024	31.75fps	35.18fps	35.47fps	36.11fps
Doom 3				
800 x 600	25.6fps	27.0fps	27.0fps	27.1fps
1,024 x 768	19.7fps	20.1fps	20.1fps	20.1fps
1,280 x 1,024	13.7fps	13.8fps	13.8fps	13.8fps

System Specs	
Component	**Model**
Motherboard	Chaintech S865PE
Processor	Celeron D 335 2.8GHz
Processor	3.2E GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

better than the next closest Celeron D Memory score. The increased Memory score may have given our processor a small lift as it tested more than 35 points higher on the S865PE than it did on our previous two boards. The Graphics score was also higher at 4702. The 3990 HDD score was about average.

We also ran timedemos on Halo and Doom 3. In Halo, the 36.95fps at 800 x 600 was the best frame rate at that resolution posted by the Celeron D thus far, but the GIGABYTE board managed to beat S865PE's 37.58fps and 31.75fps at 1,024 x 768 and 1,280 x 1,024, respectively.

Doom 3 scores, however, were consistently higher on the S865PE (albeit by a small margin). At 800 x 600 in High Quality, we managed 25.6fps. At 1,024 x 768 scores fell to 19.7fps, and increasing the resolution to 1,280 x 1,024 dropped scores to 13.7fps.

So far we've had good luck overclocking the Celeron D, and that luck continued on the S865PE. We managed to go from a 133MHz to a 153MHz FSB, increasing the processor's clock speed to 3.21GHz. The increased clock speed allowed us to reach a 6167 3DMark03 score and a 4317 PCMark04 score. Halo frame rates rose to 42.47fps, 42.90fps, and 34.45fps. Doom 3 scores showed less improvement, rising to 26.3fps, 20.0fps, and 13.8fps.

We replaced the Celeron D 335 with a 3.2E GHz Pentium 4, which uses an 800MHz FSB.

The overall PCMark04 score seemed to benefit most from the processor swap as it rose 1181 points to 4996. As expected, the faster FSB speed improved our PCMark04 Memory score to 5062. The combination of a faster FSB and a faster processor resulted in a much improved PCMark04 CPU score of 4981. Our Graphics score went to 4888, and our HDD score fell to 3910. The improvements in PCMark04 increased our 3DMark03 score to 6276.

Halo frame rates improved significantly with our 3.2GHz processor. At 800 x 600, frame rates averaged 46.83fps. At 1,204 x 768, frame rates fell just slightly to 46.34fps. Finally, at 1,280 x 1,024 we managed a solid 35.18fps. Doom 3 scores weren't much different than the scores posted by the GIGABYTE board. At 800 x 600, we managed 27.0fps. Frame rates fell to 20.1fps and 13.8fps at 1,024 x 768 and 1,280 x 1,024, respectively.

The 3.2GHz Pentium 4 didn't overclock nearly as well as our Celeron D. We managed to increase the processor's clock speed to 3.29GHz, resulting in a very slight increase in benchmark scores. Our 3DMark03 score rose to 6289, while our overall PCMark04 score rose to 5055. Our CPU score in PCMark04 actually fell slightly to 4947, but our Memory score increased to 5142, resulting in the slight overall increase. We saw a slight improvement in Halo frame rates, while Doom 3 frame rates remained virtually unchanged.

We concluded our testing with a 3.4GHz Pentium 4 Extreme Edition. PCMark04 showed the most dramatic improvement, as our overall score increased to 5402. The most improved PCMark04 component scores was the CPU score, which improved to 5160. The Memory score showed a more modest improvement to 5227, while the Graphics score showed a slight increase to 4991. The HDD score showed a slight decline at 3892. 3DMark03 showed a modest increase to 6347.

Halo scores once again showed improvement, increasing to 50.15fps, 48.38fps, and 35.47fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024, respectively. These scores, once again, were lower than the scores posted by our GIGABYTE board with the same 3.4GHz processor. Doom 3 scores remained unchanged at 27.0fps, 20.1fps, and 13.8fps.

We did have better luck overclocking the 3.4GHz Pentium 4 Extreme Edition, reaching a processor clock speed of 3.57GHz. Our overclocked 3DMark03 score rose to 6402 and our overall PCMark04 score rose to 5589 based on increases to both the CPU and Memory scores. The overclock got us a few extra frames in our Halo timedemo, while Doom 3 scores again remained largely unchanged.

Chaintech S865PE	
Socket Type	Socket 478
Chipset	Intel 865PE
Processor Support	Pentium 4 (Williamette, Northwood & Prescott), Celeron, Celeron D
RAM Support	Dual-Channel 2GB DDR266/333/400
RAM Slots	2
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	2
USB Ports	2; Headers for additional 6
FireWire Ports	0
LAN	Realtek 8101L 10/100 Ethernet
Integrated Audio	AC '97
Integrated Graphics	None
Other Features	Drivers
Manufacturer	Chaintech
Phone	886-2-2268-9998
URL	www.chaintechusa.com/tw/eng
Price	$66

Affordable Performance

If you're looking for a motherboard with integrated SATA RAID and a more robust feature package, the S865PE will disappoint. For those on a budget, however, the S865PE provides excellent performance for a modest price. CPU

Overall Rating: 2.5

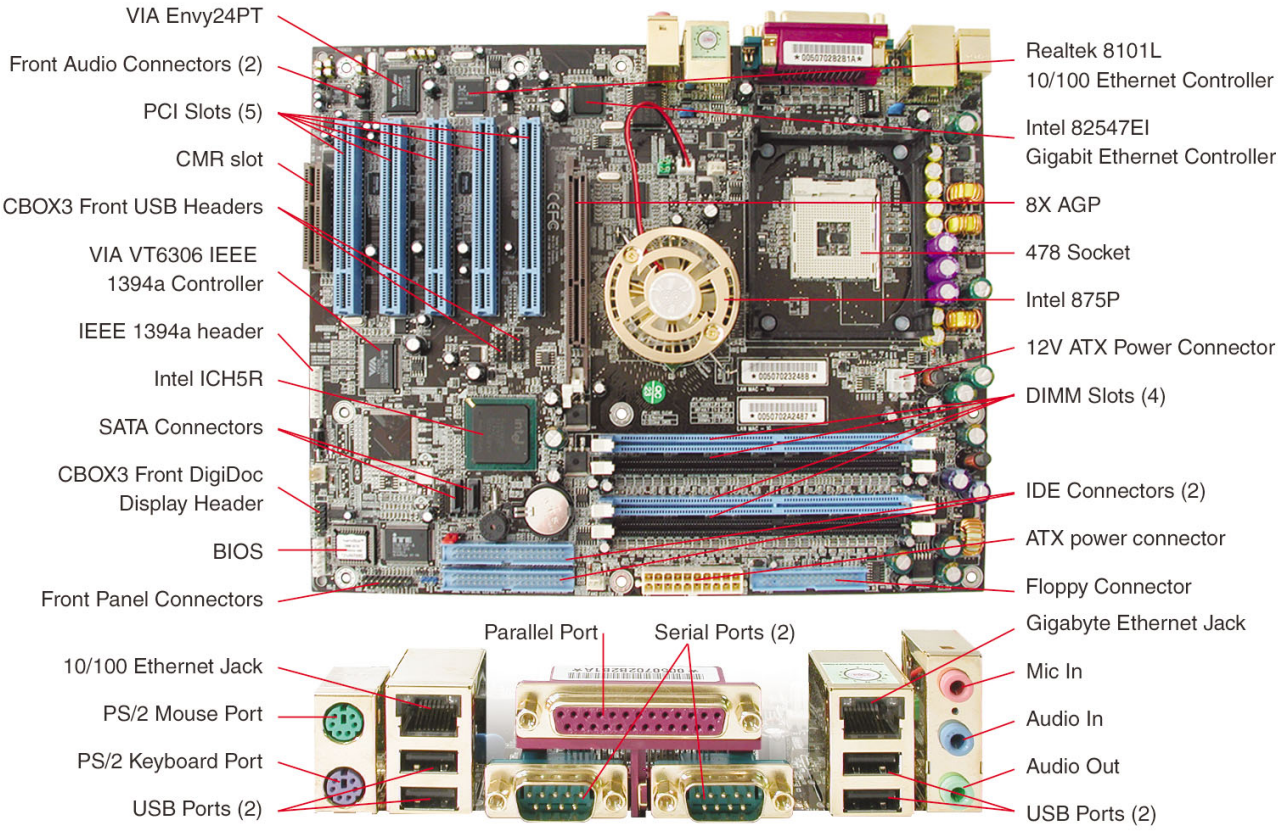
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Chaintech 9CJS Zenith

Layout: ATX (Socket 478)

Chipset: 875P



The Intel 875P was originally meant to appeal to enthusiasts looking for the utmost in performance. High prices, however, meant many enthusiasts opted for the more reasonably priced 865PE chipset instead. With Intel's new 915 and 925 chipsets coming to market, however, prices on 875P motherboards may start coming down to earth.

It's PAT

In most respects, the 875P is similar to the 865PE chipset we saw in the previous review. Both chipsets support 400MHz, 533MHz, and 800MHz FSB speeds, 8X AGP, and DDR333/400 memory. The 865PE does lack support for ECC memory, but that's not a big deal for most users. ECC memory helps reduce read/write errors, but due to its slower speed and more expensive price, ECC is typically reserved for servers.

Intel's PAT, on the other hand, is something desktop users can take advantage of. PAT uses more aggressive memory timings, reducing latency and improving memory performance when used with DDR400 memory. While PAT sounds good in theory, benchmarks typically show only a slight performance increase compared to 865PE chipsets.

The 9CJS Zenith, however, offers more than just the 875P chipset. The ICH5R on the southbridge provides SATA RAID support. The ICH5R only supports two SATA drives, so advanced RAID configurations are not possible with the ICH5R.

The ICH5R also supports up to eight USB 2.0 ports. A VIA VT6306 provides

FireWire 400 support, while an Intel PRO/1000CT controller and a Realtek RTL8101L Fast Ethernet controller provide Gigabit and 10/100 Ethernet. An integrated audio codec provides 7.1 channels of surround sound instead of 5.1 channels found on most 865PE boards.

The 9CJS Zenith also comes with a unique CBOX3 that mounts in an empty 5.25-inch drive bay. The CBOX3 includes a 6-in-1 card reader for SD, SmartMedia, Memory Stick, and other removable media.

BIOS

Before we began, we updated the motherboard's BIOS to the latest version (6.0 at press time). According to Chaintech, the latest release fixes a voltage regulation issue.

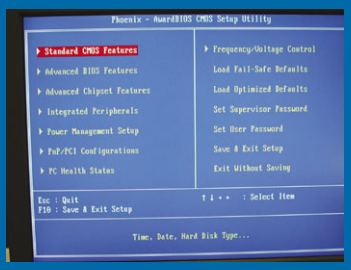
The BIOS includes a Frequency/Voltage Control section for adjusting the motherboard's FSB. By increasing the FSB, you can increase the processor's clock speed. The options offered in the Frequency /Voltage Control section should be adequate for most overclockers. Unlike the S865PE, the 9CJS Zenith lets you adjust the processor's core voltage in addition to memory and AGP voltages, although it doesn't let you set AGP and PCI speeds.

Software

The 9CJS Zenith provides all the requisite software you'd expect, including the necessary device drivers. You'll need to install third-party drivers if you're installing Windows XP on a SATA RAID system. The CD-ROM contains a utility that will copy the necessary drivers to a floppy disk, but you'll need a working system.

WinCinema Pro is included on the driver disc and lets you watch DVD movies provided you have a DVD optical drive. Additional bonus software, including Norton AntiVirus and Adobe Photoshop Album SE, are included on a bonus CD.

Performance



The 9CJS Zenith's BIOS is easy to navigate. You'll find the overclocking options in the Frequency/Voltage Control section.

Overclocking options include the ability to adjust the processor's core voltage along with memory and AGP voltages.

The CBOX3 also includes headphone and speaker jacks, but connecting them renders the rear audio ports useless. The CBOX3 also features a 2-digit display you can use to diagnose hardware problems, additional USB and FireWire ports, and an infrared receiver for the included remote control.

The 9CJS Zenith comes with a special multimedia card that fits in a proprietary Chaintech Multimedia Riser slot below the last PCI slot. The card includes audio output jacks for 7.1-channel surround sound and two extra FireWire 400 ports.

Peripheral Support

The 9CJS Zenith accommodates a wide variety of peripherals. We found four USB 2.0 ports on the back I/O panel, and the CBOX3 provides two additional ports. There is no FireWire port on the rear I/O panel, but again the CBOX3 comes to the rescue providing an easily accessible FireWire port.

We found two Ethernet ports on the rear of the system. The bottom Ethernet port provides Gigabit Ethernet while the top port provides standard 10/100 Ethernet.

The 9CJS Zenith has plenty to offer when it comes to performance. We started off testing this board with a Celeron D 335 processor running at 2.8GHz. The limited 533MHz FSB speed this processor runs at didn't seem to give this board the room it needed to really show what it can do, but performance scores were still strong.

Our 5961 3DMark03 score was five points lower than the Celeron D 3DMark03 score in our last review, but our

Performance Comparison				
Chaintech 9CJS Zenith				
Benchmark	**Celeron D 335**	**3.2E GHz Pentium 4**	**3.4GHz P4 Extreme Edition**	**3.4GHz P4 Extreme Edition Overclock (3.63GHz)**
3DMark03 Build 340	5961	6282	6366	6433
PCMark04 1.2.0	3827	5070	5465	5829
CPU	3795	4989	5320	5677
Memory	3848	5159	5414	5784
Graphics	4672	4893	4982	5032
HDD	3963	3922	3923	3952
Halo				
800 x 600	38.36fps	49.14fps	52.05fps	54.36fps
1,024 x 768	38.22fps	47.51fps	49.69fps	50.75fps
1,280 x 1,024	35.30fps	35.39fps	35.53fps	35.77fps
Doom 3				
800 x 600	26.6fps	27fps	27fps	27.2fps
1,024 x 768	20fps	20fps	20.1fps	20.2fps
1,280 x 1,024	13.8fps	13.8fps	13.8fps	13.8fps

System Specs	
Component	**Model**
Motherboard	Chaintech 9CJS Zenith
Processor	Celeron D 335 2.8GHz
Processor	3.2E GHz Pentium 4
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

overall PCMark04 score was slightly higher at 3827. We managed a 53-point increase in our PCMark04 CPU score compared to the Celeron D CPU score in our last review, but our 3848 Memory score was virtually identical. Our Graphics score suffered a bit at 4672. Our HDD score also trailed our previous review by 27 points.

Halo scores were better than our last review, but not as good as the Gigabyte GA-8IG1000 Pro-G we reviewed earlier. At 800 x 600, we managed 38.36fps. We saw a slight drop to 38.22fps when we increased the resolution to 1,024 x 768. At 1,280 x 1,024, frame rates fell to 31.94fps.

The 9CJS Zenith's Doom 3 performance was identical to the S865PE. At 800 x 600, we managed 25.6fps, with frame rates falling to 19.7fps and 13.7fps at 1,024 x 768 and 1,280 x 1,024. All tests were run under stock High Quality settings.

Our overclocked scores show significant improvement compared to our stock scores. Our 3DMark03 score increased to 6236, while our overall PCMark04 score increased to 4568. Increasing the FSB helped increase our Memory score to 4604 and gave us a 4578 CPU score. Our Graphics and HDD scores showed an increase as well, to 4843 and 4020.

The higher clock speeds produced better frame rates in Halo. We reached 45.23fps, 45.16fps, and 35.30fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024, respectively. Doom 3 scores showed a smaller increase to 26.6fps, 20.0fps, and 13.8fps.

We replaced the 2.8GHz Celeron D 335 with a 3.2E GHz Pentium 4. The 3.2E not only runs at a faster 3.2GHz, but it also utilizes a faster 800MHz FSB. The combination produced a strong 5070 PCMark04 score. Our PCMark04 CPU and Memory scores showed the greatest increase, as we managed a 4989 and 5159, respectively. Our Graphics score was a strong 4893, and our HDD score was a respectable 3922. Our 3DMark03 score was 6282.

The 800MHz FSB seemed to help the 9CJS Zenith's performance quite a bit. Nearly all the above 3.2E scores were better than those of other boards. The higher scores, however, didn't always translate into higher frame rates. In Halo, the 49.15fps was the highest Halo frame rate posted at 800 x 600. The 47.51fps and 35.39fps at 1,024 x 768 and 1,280 x 1,024, however, were trumped by the Gigabyte board. Doom 3 scores were strong, though. We managed 27fps, 20.1fps, and 13.8fps.

The 3.2E didn't overclock as well as the Celeron D 335. The 9CJS Zenith was able to get the FSB up to just 210MHz, resulting in a 3.36GHz processor clock speed.

Chaintech 9CJS Zenith	
Socket Type	Socket 478
Chipset	Intel 875P
Processor Support	Pentium 4 (Williamette, Northwood, & Prescott), Celeron, Celeron D
RAM Support	Dual Channel 4GB DDR266/333/400; ECC/Non-ECC)
RAM Slots	4
Graphics Bus	AGP
PCI Slots	5
SATA Ports	2
IDE	2
USB Ports	4; Headers on motherboard support 4 additional ports
FireWire Ports	1; Located on CBOX3
LAN	Gigabit Ethernet Controller & 10/100 Ethernet Controller
Integrated Audio	7.1-channel audio codec
Integrated Graphics	None
Other Features	Drivers; APOGEE Overclocking Utility; External CBOX3 with 6-in-1 card reader; remote control
Manufacturer	Chaintech
Phone	886-2-2268-9998 (Taiwan)
URL	http://www.chaintechusa.com/tw/eng/
Price	$165

Performance scores showed a slight improvement. Our 3DMark03 score edged up to 6325, and our overall PCMark04 score increased to 5236. Halo and Doom 3 frame rates showed little change.

Our final test processor was a 3.4GHz Pentium 4 Extreme Edition. This expensive processor boasts 2MB of L3 Cache to help improve performance. The new processor helped increase our 3DMark03 score to 6366 and our overall PCMark04 score to 5465. The 5320 CPU score and 5414 Memory score were among the best we saw in this roundup. The 4982 Graphics score and 3923 HDD score were also strong.

Strong benchmark scores didn't necessarily translate into better frame rates. The 52.05fps, 49.69fps, and 35.53fps were all bested by the Gigabyte board. Doom 3 scores were identical to the scores posted by the S865PE.

The 3.4GHz Extreme Edition overclocked better than the 3.2E GHz P4. We managed to increase the FSB to 214MHz. The 17x multiplier of the 3.4GHz P4 resulted in a 3.63GHz clock speed.

Our overclocked scores showed solid improvement over our stock scores. We managed a 6433 3DMark03 score and a 5829 overall PCMark04 score. Our CPU score increased dramatically to 5677, and the Memory score increased to 5784. Halo scores showed a slight increase while Doom 3 scores remained almost unchanged.

Final Thoughts

If you have the money, the 9CJS Zenith offers plenty of features and some of the best performance scores in this review. The higher scores also didn't result in much of a gain in Halo and Doom 3 frame rates, so if you don't need the extra features of the 9CJS Zenith, you might want to think about settling for the S865PE instead. CPU

Overall Rating:

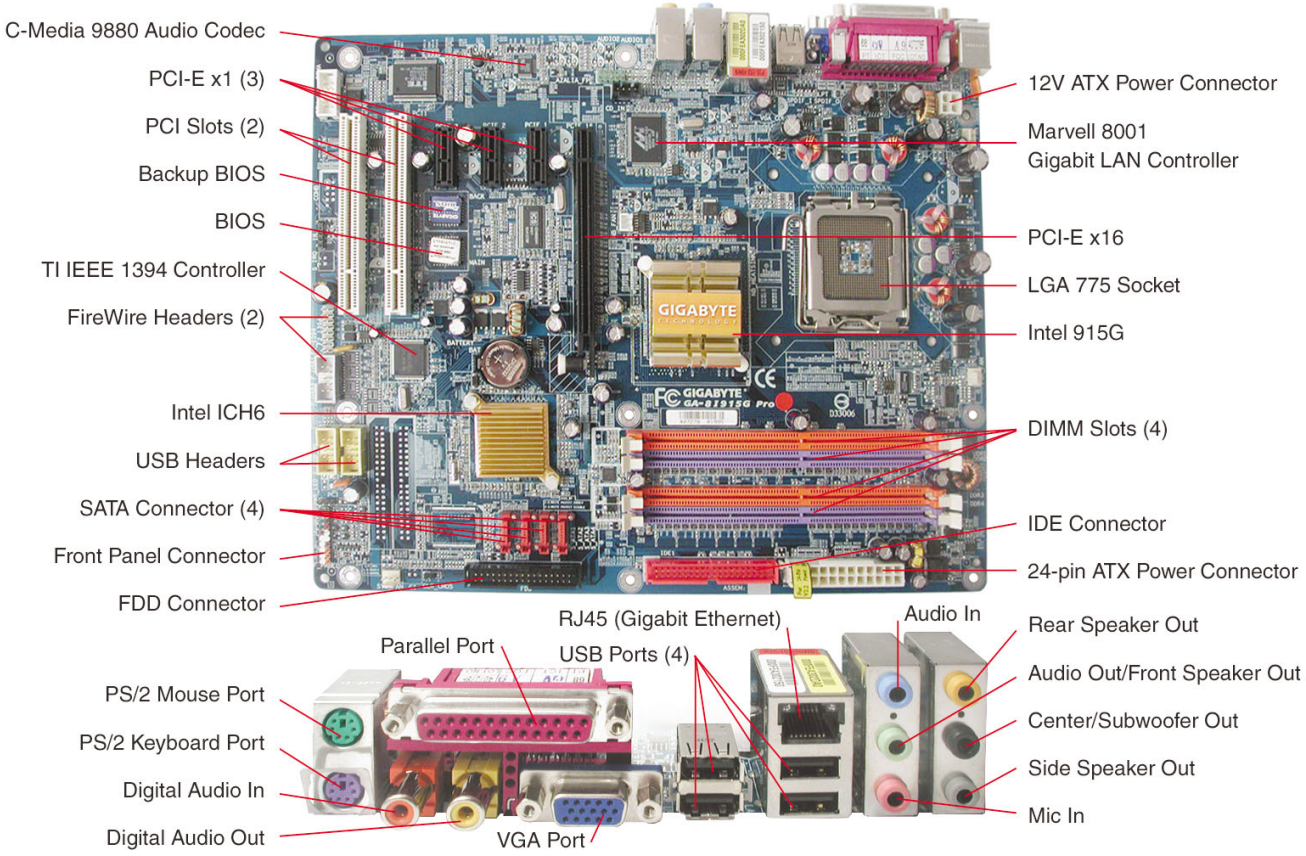
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

GIGABYTE GA-8I915G PRO

Layout: ATX (LGA775)

Chipset: 915G



We always look forward to Intel's new chips, but there's nothing like a new chipset to generate real excitement. The company's new 915 and 925 chipsets include a number of new technologies and may mark the beginning of the end for some familiar technologies. Gone completely is the now-familiar socket 478 and AGP slot. PCI slots are also beginning to disappear.

We'll explore several 915 mobos in this section. The 915 is similar to Intel's 865 and, like the 865, comes in two varieties: one with integrated graphics (the 915G) and one without (the 915P). We'll begin by looking at some 915G boards, starting with GIGABYTE's GA-8I915G Pro.

Mixing New & Old

One of the first things we noticed about the board was its LGA 775 socket. We've heard about the fragility of the new design and were a bit cautious, but the socket was less fragile than we feared. We swapped LGA 775 processors 30 times for this issue without damaging a socket.

We remember when PCI slots began replacing ISA slots. Now PCI-E x1 is beginning to replace PCI. This board still includes two PCI slots below the three new PCI-E x1 slots, but we expect we'll be seeing fewer and fewer PCI slots in the future. The new PCI-E x16 slot replaces the old AGP slot we've all become accustomed to.

Luckily, if you plan to spend your entire upgrade budget on a new board and processor, you won't *have* to go out and buy a replacement for your AGP card. The 915G sports Intel's new GMA (Graphics

The BIOS includes most of the features you'd expect to find on a high-end board. The MIT (MB Intelligent Tweaker) section contains settings relevant to overclocking.

The CIA2 options within the MIT section allow the board to increase the processor's clock speed as its workload grows. Speed increases range from 3% to 19%, depending on the setting selected and processor workload.

CMOS Setup Utility - Copyright (C) 1984-2004 Award Software
MB Intelligent Tweaker(M.I.T.)
C.I.A.2 [Disabled]
CPU Host Clock Control [Enabled]
CPU Host Frequency(Mhz) [210]
Memory Frequency For [1.66]
Memory Frequency(Mhz) 349
DIMM OverVoltage Control [Normal]
PCI-E OverVoltage Control [Normal]
CPU Voltage Control [1.60000]
Normal CPU Vcore 1.57500
Item Help
Menu Level ▸
C.I.A.2.(CPU Intelligent Accelerator 2) is designed to detect CPU loading during software program executing, and automatically adjust CPU computing power to maximize system performance
Warning: Stability is highly dependent on system components
↑↓++:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F5: Previous Values F6: Fail-Safe Defaults F7: Optimized Defaults

Media Accelerator) 900. The GMA 900 replaces the Extreme Graphics 2 that was integrated with Intel's 865G. The new GMA 900 shows improvement, but its performance is disappointing compared to moderately priced graphics cards.

You also won't have to replace your DDR memory modules, as GIGABYTE didn't include any DDR2 memory slots on this board. We suspect the few who've invested in more than 2GB of DDR will applaud this decision, as the 8I915G Pro won't limit you to 2GB of DDR. The bad news is that DDR2 isn't an option.

You may also notice the new ATX power connector, which uses a new 24-pin design rather than the old 20-pin design. PCI-E x16 can deliver a lot more juice to the video card, eliminating the need for an auxiliary power plug. Right now there's no reason to worry if you have a 20-pin PSU, as most PCI-E cards don't demand enough power to make a difference.

Along with the new 915G, the GA-8I915G Pro also includes Intel's new ICH6 on the southbridge. Some boards such as the 8I915G Pro utilize a passive heatsink on the southbridge (something rarely seen with the ICH5). The ICH6 supports four SATA ports and new technologies such as optical SATA drives and NCQ (Native Command Queuing), but Intel limited SATA support to one IDE channel.

The GA-8I915G Pro includes a C-Media 9880 audio codec that supports 7.1-channel surround sound and Intel's new High Definition Audio. A TI IEEE 1394 controller provides FireWire 400, and a Marvell 8001 provides Gigabit Ethernet.

BIOS

The system BIOS is easy to navigate and includes plenty of features. The BIOS is capable of mapping SATA drives to IDE channels, so you won't need a driver disk during Windows XP installation.

Overclocking options are located in the MIT (MB Intelligent Tweaker) portion of the BIOS. Here you can adjust the FSB speed to increase the processor's speed. You can also select memory frequency and adjust processor, memory, and PCI-E voltages. GIGABYTE also includes its CIA2 (CPU Intelligent Accelerator 2). CIA2 automatically increases the processor speed anywhere from 3% to 19%, depending on the settings selected and the processor's workload.

Performance

Compared to our other 915 boards, the 8I915G Pro's results were a little disappointing. This board posted some of the lowest benchmark scores, despite giving us some of the best Halo frame rates.

We started our testing with a 2.8GHz Intel Pentium 4 520 processor. The 4853 3DMark03 score was the lowest score among the 915 boards we reviewed. PCMark04 scores were also disappointing. The 3643 score was well below the next closest P4 520 score. The 4300 CPU score in PCMark04 was competitive with other P4 520 scores in this review, but the 4722 Memory score was more than a hundred points behind. The 3682 Graphics score was slightly behind the 3687 score posted by the P4 520 on the MSI and Intel boards. The 3911 HDD score was slightly better than the other three boards.

When it came to Halo frame rates, the GA-8I915G Pro was one of the better 915 boards. We managed 45.13fps, 41.10fps, and 28.32fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024. All but the final score bested other 915 boards. Doom 3 scores were strong, too. The board managed 27.0fps, 20.1fps, and 13.9fps at the above resolutions in High Quality.

Performance Comparison

GIGABYTE GA-8I915G Pro

Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.57GHz)
3DMark03 Build 340	**4853**	**4926**	**4955**	**4980**
PCMark04 1.2.0	**3643**	**3958**	**4139**	**4336**
CPU	4300	4909	5195	5442
Memory	4722	4980	5036	5283
Graphics	3682	3712	3722	3818
HDD	3911	3953	3973	3914
Halo				
800 x 600	45.13fps	47.64fps	48.68fps	52.03fps
1,024 x 768	41.10fps	41.89fps	41.98fps	42.24fps
1,280 x 1,024	28.32fps	28.59fps	28.45fps	28.55fps
Doom 3				
800 x 600	27.0fps	28.3fps	28.2fps	28.3fps
1,024 x 768	20.1fps	20.3fps	20.3fps	20.3fps
1,280 x 1,024	13.9fps	13.8fps	13.9fps	14.0fps

System Specs	
Component	**Model**
Motherboard	GIGABYTE GA-8I915G Pro
Processor	Pentium 4 520 2.8GHz
Processor	Pentium 4 540 3.2GHz
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ Platinum Enhanced PC4200 DDR2
Video Card	128MB Chaintech NVIDIA GeForce PCX5900
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

For the 8I915G Pro, GIGABYTE bypassed the 10% overclock limit Intel has imposed on the new chipsets. We managed to increase the FSB from 200 to 253MHz, pushing the P4 520's clock speed from 2.8 to 3.52GHz. The increase really helped scores, as our 3DMark03 score increased to 4988 and our overall PCMark04 score increased from a disappointing 3643 to a strong 4349. Our PCMark04 CPU score rose to 5325, and our Memory score increased to 5774. Our Graphics and HDD scores rose to 3807 and 3920.

Halo frame rates improved to 49.18fps, 42.32fps, and 28.63fps. Doom 3 frame rates rose to 27.6fps, 20.4fps, and 14.0fps.

When we yanked out our PCI-E video card to test Intel's new GMA 900, our 3DMark03 scores plummeted to 1319 and our PCMark04 Graphics score sank to 1088.

Next, we replaced the P4 520 with a P4 540 running at 3.2GHz and posted an improved 4926 3DMark03 score and a 3958 overall PCMark04 score, though these numbers were low compared to other P4 540 scores. The PCMark04 score was 745 points lower than the next closest P4 540 score. The 4909 CPU score was average, but the 4980 Memory score was more than 100 points below the other 915 boards we examined. The 3712 and 3953 Graphics and HDD scores were average.

Halo frame rates, however, were still strong. At 800 x 600 and 1,024 x 768, the GA-8I915G Pro again posted the best scores of the 915 boards we reviewed (47.64fps and 41.89fps, respectively). The 1,280 x 768 score of 28.59fps was a bit lower than the score from the ASUS board we'll review later. Doom 3 scores were strong at 28.3fps, 20.3fps, and 13.8fps.

P4 540 didn't overclock as well as the P4 520. We got the FSB up to 233MHz, resulting in a 3.76GHz processor clock speed. The overclock increased our 3DMark03 scores to an even 5000, while our 4549 overall PCMark04 score showed greater improvement. The 5666 CPU score was more than 700 points better than the stock CPU score, and our Memory score increased dramatically to 5692. The 3841 Graphics score was up a bit, and the 3915 HDD score was down slightly.

Halo scores increased to 49.52fps, 42.35fps, and 28.60fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024. Doom 3 scores increased to 28.6fps, 20.4fps, and 14.0fps at the above resolutions.

We tested the GMA 900 with the P4 540 running at its stock clock speed. The 1354 3DMark03 score was much better than the P4 520's score, but the 1117 PCMark04 Graphics score was only a bit higher than the P4 520's score.

Our final processor was a 3.4GHz Pentium 4 Extreme Edition. At 4995, our 3DMark03 score was again slightly low, while our 4139 PCMark04 score was so far off the pace it was figuratively getting lapped. The closest score was 842 points better. The 5195 CPU score was strong, but again the 5036 Memory score trailed other boards. The 3973 HDD and 3722 Graphics scores were about average.

Halo frame rates, however, were excellent. At 800 x 600 and 1,024 x 768, the GA-8I915G Pro managed 48.68fps and 41.98fps. Doom 3 scores were competitive at 28.2fps, 20.3fps, and 13.9fps.

We had less luck overclocking the 3.4GHz P4 Extreme Edition. We managed to increase the FSB just 10MHz to 210MHz. This pushed the processor's clock speed to 3.57GHz and resulted in modest performance improvements. Our 3DMark03 score rose to 4980 and our overall PCMark04 score rose to 4336, with 5442 CPU and 5283 Memory scores.

Yanking out the video card, we saw our 3DMark03 score tumble to a measly 1430. Our PCMark04 Graphics score also took a nosedive, falling to 1124.

GIGABYTE GA-8I915G Pro	
Socket Type	LGA 775
Chipset	Intel 915G
Processor Support	Pentium 4 LGA 775 processors
RAM Support	Dual Channel 4GB DDR333/400
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	2
PCI-E x1	3
SATA Ports	4
IDE	1
USB Ports	4; headers on motherboard support 4 additional ports
FireWire Ports	2 located on included bracket; additional header supports one extra port
LAN	Gigabit Ethernet Controller and 10/100 Ethernet Controller
Integrated Audio	C-Media 9880 Audio Codec (7.1-channel)
Integrated Graphics	Intel Graphics Media Accelerator 900
Other Features	CPU Intelligent Accelerator 2; Memory Intelligent Booster 2; EasyTune 5; Motherboard Intelligent Tweaker; System Overclock Saver; Norton Internet Security 2004
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	www.giga-byte.com
Price	$137

Final Thoughts

PCMark04 Memory scores seem to suggest that this board's performance suffers a bit from its neglect of DDR2. Looking at Halo and Doom 3 frame rates, however, it's hard to argue that reliance on DDR has a serious impact on performance. We're not fond of Intel's GMA 900, but if you're planning a slow transition, GMA 900 can buy you a little time to save up for a decent PCI-E x16 card. CPU

Overall Rating:

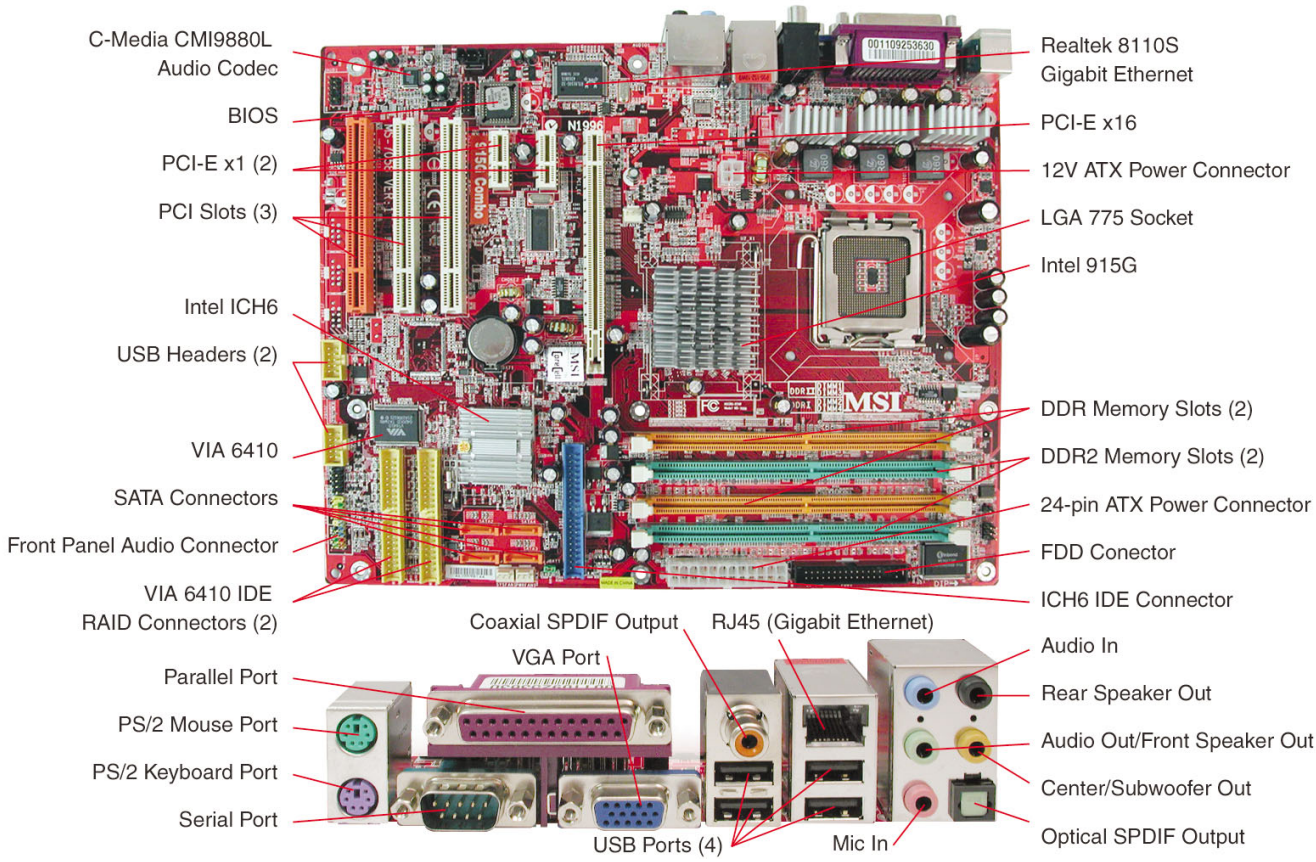
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

MSI 915G Combo-FR

Layout: ATX (LGA 775)

Chipset: 915G



MSI has a reputation for making quality motherboards, and we had high hopes for the MSI 915G Combo-FR motherboard when we first removed it from the box. Unfortunately, the motherboard layout was less than impressive, leaving us a little disappointed.

Chipsets

Like the GIGABYTE board we looked at previously, the MSI 915G Combo-FR features Intel's new 915G chipset. The GMA 900 integrated graphics are better than the Extreme Graphics 2 integrated into the 865G chipsets, but it's still lacking compared to a moderately priced graphics card. Unlike the GIGABYTE board we looked at previously, the 915G Combo-FR includes two DDR and two DDR2 slots. The one downside to this configuration is that it only supports 2GB of either DDR or DDR2.

Although the back of the box talks about SATA RAID and the instructions give the impression that SATA RAID is available on some 915G/P Combo-FR motherboards, this is not the case. Our 915G Combo-FR, like the 915P Combo-FR, features an Intel ICH6 on the southbridge. The ICH6 provides support for four SATA drivers and one IDE channel. A VIA 6410 chip does provide IDE ATA on two additional IDE channels.

Our MSI board includes integrated Intel High Definition audio via its C-Media 9880L audio codec. The 915G Combo-FR not only includes additional audio jacks for 7.1-channel speaker systems but also includes a coaxial and optical SPDIF outputs. An integrated Realtek 8110S provides integrated Gigabit Ethernet. The back I/O panel includes four USB ports, and an included bracket provides two additional USB ports. The bracket also includes four LEDs you can use for troubleshooting and diagnostic purposes. If you have additional USB ports on your chassis or on an optional component, you can use the remaining USB header.

Layout

The 915G Combo-FR has to have one of the worst layouts we've seen. For some reason, MSI placed the only IDE connector controlled by the ICH6 at roughly the same height as our PCI-E x16 slot. Our Chaintech GeForce PCX 5900 overlapped part of the IDE connector, rendering it impossible to have our optical drive and video card installed at the same time (lucky for us, the board has integrated video). Our video card was part of the problem, but none of the other boards we looked at placed the IDE connector in such a perilous position.

BIOS

The BIOS offers a number of options for overclockers in the Cell_Menu. From here, you can overclock the motherboard and memory by increasing the frontside bus speed. We liked the fact that MSI displayed memory and CPU frequency within this menu, as it provides you with all the relevant information about the system in one place. You can adjust the memory frequency by selecting DDR400 (2x200MHz) or DDR533 (2x266MHz). You can also adjust the PCI frequency and voltage for the CPU, memory, and PCI Express. The voltage numbers change color from white (safe) to yellow to red (dangerously high) as you increase the voltage.

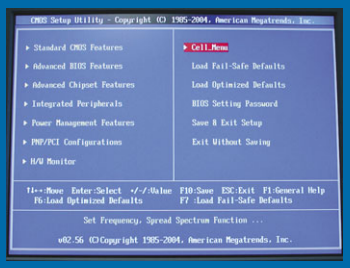
We do have one complaint about the BIOS. Resetting the BIOS causes the date and time to reset, as well. We didn't catch this at one point, causing Windows XP to think its 30-day grace period had expired after we reset the date and time. This is primarily a problem for those who test a lot of hardware, as most users will activate their copy of WinXP.

Performance

The MSI 915G Combo-FR posted stronger overall scores compared to the GIGABYTE board we reviewed previously. We started our testing with a Pentium 4 520 processor running at 2.8GHz and managed a solid 4879 3DMark03 score. The score was much lower than the ASUS P5GD2 we'll review in a bit but slightly better than the Intel motherboard we'll examine next. The 4198 PCMark04 score was well ahead of the 3643 posted by the P4 520 in our last review. Compared to the Intel and ASUS boards, the score was a little low, but not by much. The 4319 PCMark04 CPU score was on par with scores posted by other boards in this review as was the 4845 Memory score. The 3687 Graphics score was strong, although it was well below the score from our ASUS board. The 3895 HDD score, however, was one of the lowest HDD scores we recorded.

Halo frame rates were strong relative to other P4 520 scores. We managed 42.52fps at 800 x 600, 38.69fps at 1,024 x 768, and 27.77fps at 1,280 x 1,024. Doom 3 scores, for the most part, were just below the Intel and ASUS boards but better than the GIGABYTE board. In High Quality we managed 27.1fps, 20.2fps, and 14.0fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024.

Unlike the GIGABYTE board in our last review, we had some problems overclocking the P4 520 on the MSI 915G Combo-FR. We managed to increase the FSB to 218MHz, resulting in a 3.05GHz processor clock speed. With our modest speed increase came modest performance increases. Our 3DMark03 score rose to 4949, and our overall PCMark04 score



The BIOS has all the options you'd expect on a 915 board. The Cell_Menu provides access to the overclocking options.

MSI color codes voltages to give users an idea when they may be using an unsafe voltage. Of course, you can always ignore the warning if you think you know better.

Performance Comparison				
MSI 915G COMBO-FR				
Benchmark	**Pentium 4 520 2.8GHz**	**Pentium 4 540 3.2GHz**	**3.4GHz P4 Extreme Edition**	**3.4GHz P4 Overclock (3.57GHz)**
3DMark03 Build 340	**4879**	**4947**	**4962**	**5011**
PCMark04 1.2.0	**4198**	**4745**	**5003**	**5725**
CPU	4319	4935	5185	5434
Memory	4845	5115	5180	5562
Graphics	3687	3722	3730	3799
HDD	3895	3925	3976	3941
Halo				
800 x 600	42.52fps	45.47fps	45.95fps	47.14fps
1,024 x 768	38.69fps	40.26fps	40.51fps	41.15fps
1,280 x 1,024	27.77fps	28.13fps	27.98fps	28.08fps
Doom 3				
800 x 600	27.1fps	27.4fps	27.4fps	27.6fps
1,024 x 768	20.2fps	20.4fps	20.4fps	20.5fps
1,280 x 1,024	14fps	14fps	14fps	14fps

increased to 4580, with the CPU score increasing more than 400 points to 4732. Our Memory score also showed dramatic improvement to 5282.

Returning to our stock speeds, we yanked our Chaintech PCX 5900 and installed the GMA 900 integrated video drivers. Again, the performance scores were disappointing, as our 3DMark03 score fell to 1475 and our PCMark04 Graphics score fell to 1114.

We replaced the P4 520 with a P4 540 running at 3.2GHz. Our 3DMark03 score saw a modest improvement, with the new processor pushing the score to 4947, while our PCMark04 overall score saw more dramatic improvements, increasing to 4745. Our PCMark04 CPU score increased more than 600 points to 4935, and our Memory score went above 5000 for the first time to 5115. Our Graphics score increased slightly to 3722, and our HDD posted a stronger 3925.

The new processor increased our Halo frame rates to 45.47fps, 40.26fps, and 28.13fps. Doom 3 scores also improved slightly to 27.4fps and 20.4fps at 800 x 600 and 1,024 x 768. At 1,280 x 1,024, Doom 3 frame rates were identical to our P4 520 score of 14.0fps. All scores compared well with the competition. The lone exception came from the ASUS board we'll review later this issue, which had a standout 3DMark03 score.

System Specs	
Component	**Model**
Motherboard	MSI 915G COMBO-FR
Processor	Pentium 4 520 2.8GHz
Processor	Pentium 4 540 3.2GHz
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ Platinum Enhanced PC4200 DDR2
Video Card	128MB Chaintech NVIDIA GeForce PCX5900
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

In our previous review, the GIGABYTE board did a better job overclocking the P4 520 than the P4 540. This time around, the P4 540 overclocked better than the P4 520. We managed to increase our FSB to 233MHz, resulting in a 3.76GHz processor clock speed. The increased speed put us just two points shy of the 5000 mark in 3DMark03 and increased our PCMark04 overall score to 5154. Our PCMark04 Memory score showed the most improvement, climbing more than 500 points to 5645, while our CPU score increased more than 400 points to 5376.

Returning to the system's default speed and removing the PCI-E video card, we once again saw our video scores plummet. Our 3DMark03 score dropped to 1528, while our PCMark04 Graphics score fell to 1133.

Our final processor was a 3.4GHz Pentium 4 Extreme Edition. The extra 2MB of L3 Cache on the P4 EE resulted in slight improvements to our 3DMark03 score and most PCMark04 scores. Again, the 4962 3DMark03 score was a little low compared to the Intel board we'll look at next and much lower than our ASUS board. The 5003 overall PCMark04 score was second best next to the Intel board. The 5185 CPU score, interestingly enough, was 10 points lower than the score posted by the GIGABYTE board in our last review, but 111 points better than the CPU score posted by the ASUS P5GD2 Deluxe that managed all those standout 3DMark03 scores. The 5180 Memory score was very strong compared to other 915 boards, as was the 3730 Graphics score and 3976 HDD score.

Once again, Halo and Doom 3 frame rates were competitive. We managed 45.95fps, 40.51fps, and 27.98fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024. The 915G Combo-FR didn't do as well on Doom 3 as the GIGABYTE and ASUS boards. We managed 27.4fps, 20.4fps, and 14.0fps.

We typically don't have much luck overclocking the 3.4GHz P4 EE, so we weren't surprised we were only able to push the FSB up to 210MHz. At 3.57GHz, our processor scored a 5011 3DMark03 score and a 5725 PCMark04 overall score. The 5434 CPU score we received was the highest score posted by any processor on this board, despite the fact that the P4 540 was running at 3.76GHz. The Memory score also showed marked improvement at 5562.

Without the video card, we managed meager scores at default clock speeds. Our 3DMark03 score fell to 1586, and our PCMark04 score fell to 1152.

MSI 915G COMBO-FR	
Socket Type	LGA 775
Chipset	Intel 915G
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual-channel 2GB DDR333/400/dual-channel 2GB DDR2 400/533
RAM Slots	4 (2 DDR/2 DDR2)
Graphics Bus	PCI-E x16
PCI Slots	3
PCI-E x1	2
SATA Ports	4
IDE	3 (2 RAID)
USB Ports	4; Headers on motherboard support 4 additional ports
FireWire Ports	0
LAN	Realtek 8110S GIGABYTE Ethernet Controller
Integrated Audio	C-Media 9880L Audio Codec (7.1-channel)
Integrated Graphics	Intel Graphics Media Accelerator 900
Other Features	Live Update, Fizzy Logic, PC Alert, MSI CoreCell, CoreCenter, DigiCell
Manufacturer	MSI
Phone	(626) 913-0828
URL	www.msicomputer.com
Price	$140

Final Thoughts

Compared to the GIGABYTE board we looked at previously, the MSI 915G Combo-FR seemingly provides a much better upgrade path for users who don't want to invest in a new video card and memory along with a new processor and motherboard. Unfortunately, we have to deduct some points for the placement of the ICH6 IDE connector. If you plan to use a PCI-E video card, you'll need to make sure it won't interfere with this connector. CPU

Overall Rating:

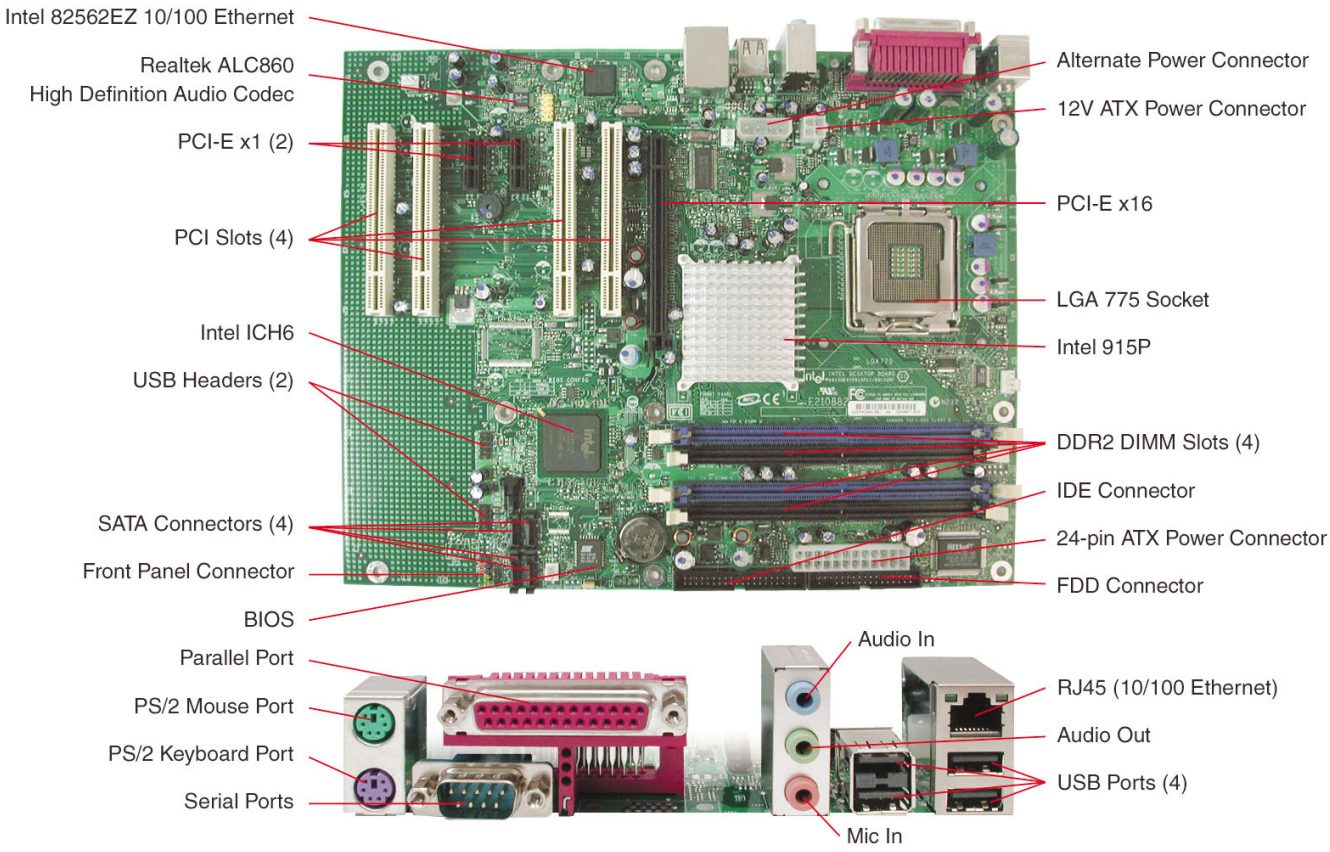
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Intel D915PCYL

Layout: ATX (LGA 775)

Chipset: 915P



Intel's 915G chipset provides a nice upgrade path for many users by eliminating the need for a new PCI-E graphics card. Both the 915G boards we looked at also support DDR memory, so new users won't have to invest in DDR2 right away. Intel's Graphics Media Accelerator 900 that comes integrated with its 915G chipset, however, isn't all that great. If you run more demanding 3D applications or video games, you'll probably want to invest in a solid PCI-E video card. If you opt to jump in with both feet, we recommend looking at a 915P chipset. The lack of integrated video makes the 915P a little less expensive in some cases.

Intel's boards have a reputation for stability and performance, but they also tend to push new technology to a greater extent. Intel boards are typically not very popular with enthusiasts because they lack overclocking options. If you're not interested in voiding your warranty, however, Intel's boards are often worth a closer look. The D915PCYL runs Intel's 915P chipset.

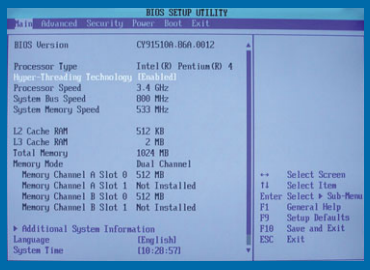
On The Board

Technically, the 915P supports both DDR and DDR2, but Intel wants to push the new DDR2 standard, so you won't find any DDR slots on this board. Instead you'll find four DDR2 memory slots, allowing this board to support up to 4GB of DDR2 400/533 memory.

Naturally, the D915PCYL also includes an LGA 775 socket. ASUS does have a 915P board that uses Socket 478, but nearly all 915 boards use the new processor socket. Foxconn makes the physical socket for nearly all 775 boards, so there's no physical difference in the socket from one board to the next.

Intel doesn't put a fan on the northbridge heatsink, but the heatsink itself is huge. The heatsink is a little close to the mounting holes used for the new CPU heatsinks, making it a little difficult to unlock the pin closest to the CPU heatsink.

Intel pairs the 915P with its ICH6 on the southbridge. This was the only 915 board we looked at that didn't include a heatsink on the southbridge. The ICH6 doesn't support RAID, but it does support four SATA drives and new standards


BIOS SETUP UTILITY
Main Advanced Security Power Boot Exit
BIOS Version CY915100.86A.0012
Processor Type Intel(R) Pentium(R) 4
Hyper-Threading Technology [Enabled]
Processor Speed 3.4 GHz
System Bus Speed 800 MHz
System Memory Speed 533 MHz
L2 Cache RAM 512 KB
L3 Cache RAM 2 MB
Total Memory 1024 MB
Memory Mode Dual Channel
Memory Channel A Slot 0 512 MB
Memory Channel A Slot 1 Not Installed
Memory Channel B Slot 0 512 MB
Memory Channel B Slot 1 Not Installed
Additional System Information
Language [English]
System Time [10:20:57]
↔ Select Screen
↑↓ Select Item
Enter Select ▸ Sub-Menu
F1 General Help
F9 Setup Defaults
F10 Save and Exit
ESC Exit

The Main section provides you with handy information on your system.

The Burn In option in the Advanced section will stress the system, but it's not an overclocking tool.

Performance Comparison				
Intel D915PCYL				
Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock
3DMark03 Build 340	**4864**	**4938**	**4974**	**N/A***
PCMark04 1.2.0	**4201**	**4713**	**5025**	**N/A***
CPU	4312	4942	5211	N/A*
Memory	4846	5137	5205	N/A*
Graphics	3687	3723	3733	N/A*
HDD	3947	3866	3912	N/A*
Halo				
800 x 600	41.35fps	44.05fps	47.97fps	N/A*
1,024 x 768	38.52fps	39.81fps	41.41fps	N/A*
1,280 x 1,024	27.67fps	27.83fps	28.21fps	N/A*
Doom 3				
800 x 600	27.2fps	27.4fps	27.4fps	N/A*
1,024 x 768	20.3fps	20.4fps	20.4fps	N/A*
1,280 x 1,024	14.0fps	14.0fps	14.0fps	N/A*
*Board includes no overclocking options.				

for emerging SATA optical drives. The ICH6 marks the beginning of the end for old IDE devices. The new chipset only supports one IDE connector for a total of two drives. Some motherboard manufacturers are adding an additional IDE controller (usually for IDE RAID), but not Intel. The ICH6 also provides support for up to eight USB 2.0 ports. The ICH6 doesn't support FireWire.

Intel must've decided it didn't need to use the entire ATX board. The bottom-right corner of the board is completely devoid of any chips or electrical pathways, giving the board an odd look.

Integrated components include Intel's new High Definition audio codec in the form of a Realtek ALC860 audio codec. Intel is pushing Gigabit Ethernet, but the D915PCYL only includes 10/100 Ethernet via Intel's 82562EZ controller.

Intel does include four standard PCI slots. In addition to the single PCI-E x16 slot available, the D915CYL also includes two PCI-E x1 slots.

BIOS

We didn't care much for the BIOS interface. The layout divides options up into several categories listed as tabs along the top of the screen. Arrow keys move you among tabs. The problem we have with this layout is that we sometimes accidentally use the left and right arrows when adjusting the date and time, causing us to move to another section.

You'll find the hardware information and hardware monitoring options you're used to seeing in a BIOS. The BIOS does feature a Burn In option that stresses the system, but don't confuse this for an overclocking option. Intel does not cater to the overclocking market and is known to throw up overclocking roadblocks from time to time. With the 915 and 925 chipsets, Intel has managed to create a 10% overclock limit that prevents users from raising the FSB beyond 220MHz. Some manufacturers have found a way past this limitation, but it's clear Intel doesn't want people overclocking its processors. It's no surprise, then, that the BIOS doesn't allow you to increase the motherboard's FSB.

Software

The CD-ROM includes chipset, audio, and Ethernet drivers along with a few desktop utilities. You won't find any bonus software with Intel's motherboards. The D915PCYL, for instance, doesn't come with the multimedia and security suites that accompany boards from other manufacturers.

Performance

Intel has a reputation for excellent performance at default clock speeds, and our benchmarks gave us no reason to challenge this reputation. We began our testing, as in our previous 915 reviews, with an Intel Pentium 4 520 processor running at 2.8GHz.

Nonetheless, we didn't get off to a very good start with this board. The 4864 3DMark03 score wasn't too great compared to the MSI board we reviewed previously and the ASUS board we'll look at next. In fact, the ASUS board's P4 520 3DMark03 score was 267 points better.

Our PCMark04 scores, however, were more consistent with P4 520 scores from other boards. The 4201 overall PCMark04 score was just slightly behind the ASUS board, as were the 4312 CPU, 4846 Memory, and 3947 HDD scores. The 3687 Graphics score, however, was much lower than the standout score the ASUS board posted.

System Specs	
Component	Model
Motherboard	Intel D915PCYL
Processor	Pentium 4 520 2.8GHz
Processor	Pentium 4 540 3.2GHz
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ Platinum Enhanced PC4200 DDR2
Video Card	128MB Chaintech NVIDIA GeForce PCX5900
Hard Drive	80GB Maxtor 6Y080M0
	SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD+/-RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

The D915PCYL posted the lowest Halo frame rates of any 915 board. The system averaged 41.35fps at 800 x 600, 38.52fps at 1,024 x 768, and 27.67fps at 1,280 x 1,024. The last two scores were just a tenth of a second or so below the scores posted by the MSI board, so while these scores are low, they aren't too far off the pace.

The D915PCYL did a little better on Doom 3. In High Quality we managed 27.2fps at 800 x 600, 20.3fps at 1,024 x 768, and 14.0fps at 1,280 x 1,024.

Again, the D915PCYL doesn't support overclocking. You can find system information (including processor specifications and FSB speeds) in the BIOS, but Intel doesn't allow you to increase the FSB. We swapped the P4 520 for a P4 540 running at 3.2GHz.

The processor's clock speed led to some pretty decent performance gains, although relative to other P4 540 scores the D915PCYL was still positioned between the MSI board in the last review and the ASUS board. With the P4 540, the D915PCYL managed a 4938 3DMark03 score, which was just 9 points below the 4947 posted by the MSI board and more than 200 points below the 5161 score posted by the ASUS board.

The 4713 overall PCMark04 score, on the other hand, bested the 4703 posted by the ASUS board while trailing the 4745 score posted by the MSI board. The 4942 CPU score was the best P4 540 CPU score we received from our 915 boards. The 5137 Memory score was strong, although it trailed the P4 540 Memory score posted by the ASUS. The 3866 HDD score was the lowest HDD score of any of our 915 boards.

Once again, the D915PCYL took longer than any other board to complete the Halo timedemos. At 800 x 600, we managed 44.05fps. Increasing the resolution to 1,024 x 768 caused frame rates to drop to 39.81fps. Finally, at 1,280 x 1,024, frame rates dropped to 27.83fps.

Doom 3 scores were identical to those posted by the MSI board in our last review. The system averaged 27.4fps at 800 x 600 and 20.4fps at 1,024 x 768. Frame rates bottomed out at 14.0fps at 1,280 x 1,024.

Our final test processor was a 3.4GHz Pentium 4 Extreme Edition. For whatever reason, this board really seemed to shine with this processor, posting some of the best 915 scores in this issue.

The 4947 3DMark03 score still couldn't compete with the standout scores we received from the ASUS board. In fact, we only saw a very slight increase over the P4 540 3DMark03 score. The 5025 PCMark04 score, however, was the best stock PCMark04 score we received from any 915 board, as were the 5211 CPU and 5205 Memory scores. The 3733 Graphics score was slightly higher than the MSI board we looked at in our last review, but more than 200 points below the ASUS board. The 3912 HDD score was a little low, but not too far off the pace.

Our Extreme Edition processor had a positive effect on our Halo scores. At 800 x 600, we averaged 47.97fps. That average fell to 41.41fps when we increased the resolution to 1,024 x 768. At 1,280 x 1,024, the resolution fell to 28.21fps. All three scores were better than the MSI board, although they still trailed the ASUS and GIGABYTE boards.

Once again, Doom 3 scores were identical to the MSI scores we recorded in our last review. We averaged 27.4fps, 20.4fps, and 14.0fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024.

Intel D915PCYL	
Socket Type	LGA 775
Chipset	Intel 915P
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533)
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	4
PCI E x1	2
SATA Ports	4
IDE	1
USB Ports	4; Headers on motherboard support 4 additional ports
FireWire Ports	0
LAN	Intel 82562EZ 10/100 Ethernet Controller
Integrated Audio	Realtek ALC860 7.1-channel audio
Integrated Graphics	None
Other Features	Drive Disk
Manufacturer	Intel
Phone	(800) 538-3373
URL	www.intel.com
Price	$119

Final Thoughts

Although it's not difficult to find Intel motherboards at retail outlets, it's evident by looking at Intel's packaging that the company doesn't pursue the retail market too aggressively. The D915PCYL comes in a rather plain package. Intel does provide you with everything you need including SATA, IDE, and floppy cables, but it doesn't provide you with anything extra. On the software front, expect drivers and a handful of desktop utilities from Intel.

Compared to the 915G boards we looked at, upgrading to the D915PCYL is going to be a little more expensive. In order to use this board, you'll need to invest in DDR2 memory, which may end up being a costly endeavor. Remember when the P4 first came out and Intel was pushing Rambus? That didn't turn out too well for early adopters who invested in new and expensive Rambus modules. You'll also need a new PCI-E x16 graphics card, as the 915P doesn't include integrated graphics.

At $120, the D915PCYL is one of the least expensive 915 boards we've looked at. Nonetheless, we'd recommend the GIGABYTE 8I915G Pro or ASUS P5GD2 Deluxe over the D915PCYL. You'll pay more, but you'll get more. CPU

Overall Rating: 2.5

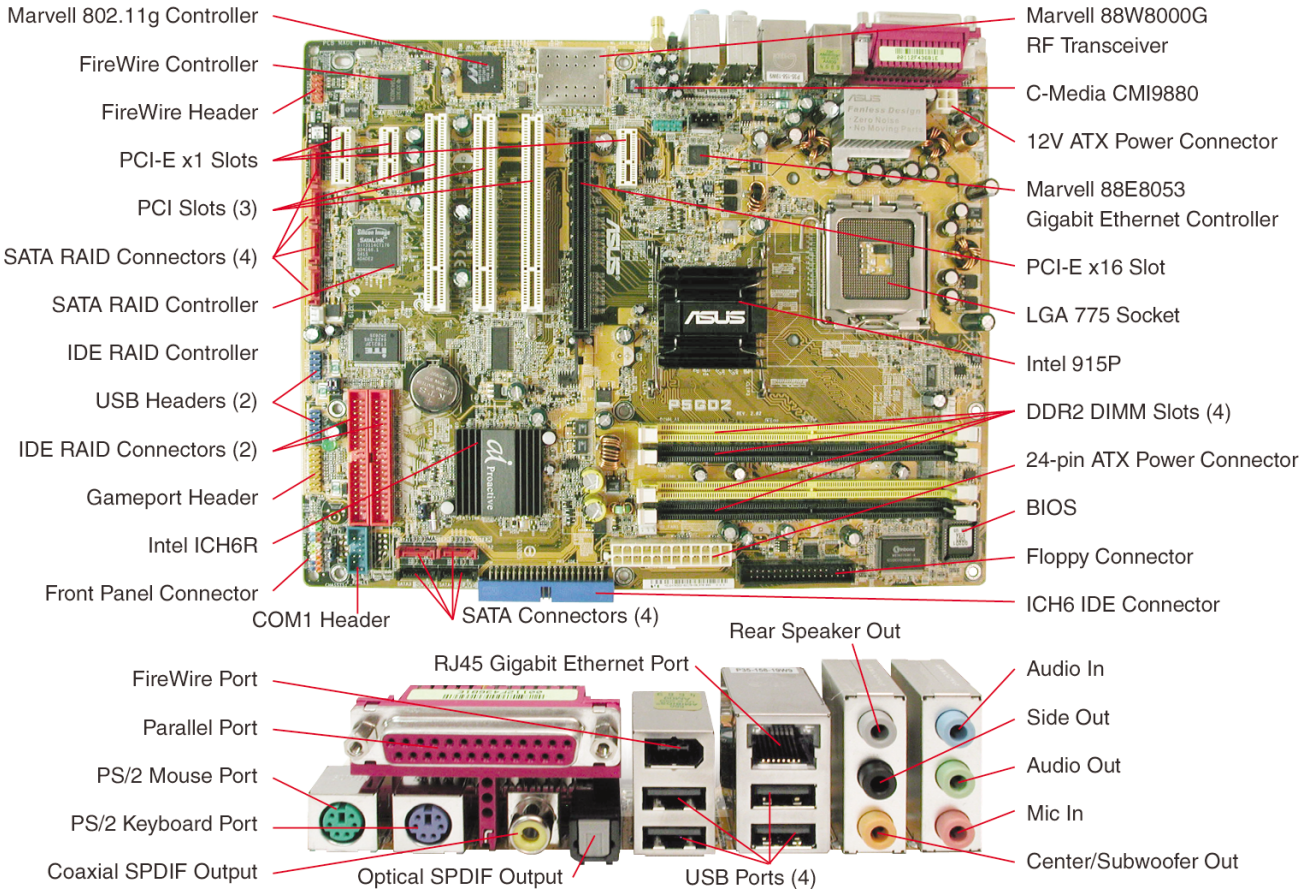
by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

ASUS P5GD2 Deluxe

Layout: ATX (LGA 775)

Chipset: 915P



The ASUS P5GD2 Deluxe really shouldn't disappoint ASUS fans, as it includes integrated 802.11g, SATA RAID, and Gigabit Ethernet, giving this board one of the best feature packages of any of the 915 boards we've looked at.

Like the Intel board we looked at previously, however, there are no easy upgrade paths. This board doesn't support DDR memory, and its new PCI-E x16 graphics slot renders your semi-new AGP card useless. To make matters worse, the P5GD2 is one of the more expensive 915 boards we've looked at.

Puzzle Pieces

The P5GD2 uses an Intel 915P chipset. The 915P's lack of integrated video coupled with its PCI-E x16 graphic support means you'll need to go out and buy a new video card (not that you need an excuse). Although the 915P supports DDR and DDR2, the P5GD2 doesn't include any DDR memory slots, so you'll need to use all-new DDR2 memory for this board. By choosing not to support both memory types, the P5GD2 can support a complete 4GB of DDR2.

The P5GD2 Deluxe includes an Intel ICH6R on the southbridge. As you can probably guess, the R denotes SATA RAID support. The ICH6R supports four SATA drives, twice as many as the old ICH5R. This makes it possible to support more complex RAID arrays, such as RAID 0+1. Intel's new MATRIX technology goes one step further by letting you mirror and stripe data across just two SATA drives.

If you have a couple of older IDE hard drives, you can also take advantage of IDE RAID. The ICH6R only supports one IDE channel, but an ITE 8212F provides two additional IDE channels to support IDE RAID. If that's not enough

RAID for you, the P5GD2 also includes a Silicon Image SATA RAID Controller that lets you combine up to four additional SATA drives into a RAID array.

ASUS went ahead and provided integrated 802.11g on the P5GD2. The board includes an antenna that screws onto a connector on the rear I/O panel. The included software walks you through the process of configuring your wireless network. If you already have Ethernet running, you can take advantage of the integrated Gigabit Ethernet provided by the Marvell 88E8053.

The C-Media audio codec provides 7.1 channels of high-definition audio. The P5GD2 includes coaxial and optical SPDIF output on the rear I/O panel.

In addition to the SPDIF output on the rear I/O panel, you'll also find four USB 2.0 ports. An additional bracket provides two more USB ports and a game port for older game controllers. The I/O panel includes a FireWire 400 port. An additional bracket includes one more FireWire 400 port.

Software

ASUS provides plenty of software in addition to the necessary hardware drivers. The ASUS LiveUpdate Utility lets you download the latest BIOS updates from the Internet or flash your BIOS from a file without leaving Windows. ASUS PC Probe provides hardware monitoring and lets you adjust the FSB speed from Windows. In addition to the various motherboard utilities, you'll also find Norton AntiVirus 2004 and InterVideo WinDVD Suite.

BIOS

After manually resetting the MSI CMOS, we appreciated the ASUS Crash Free BIOS on the P5GD2. The Crash Free BIOS automatically resets the BIOS to the last good configuration if the motherboard fails to POST.

You can find overclocking options in the JumperFree Configuration option under the Advanced tab. The P5GD2 includes a variety of overclocking options. We selected Manual for our AI Overclocking option and were presented with a number of additional options. In addition to setting the FSB frequency, you can also adjust frequencies for memory and PCI-E.

Performance

The P5GD2 Deluxe seemed to post some standout PCMark04 Graphics scores, which probably helped contribute to this board's standout 3DMark03 scores. Other PCMark04 scores were competitive, although they didn't stand out to the same extent the Graphics and 3DMark03 scores stood out. Frame rates were generally good.

We started out testing, with a Pentium 4 520 running at 2.8GHz. We were impressed by the board's 5131 3DMark03 score. This score was more than 150 points better than the 3DMark03 score posted by the Intel D915PCYL with the 3.4GHz Pentium 4 Extreme Edition.

PCMark04 scores, however, were less impressive. The 4213 overall score was still the best P4 520 score we recorded, although it didn't stand out to the extent the 3DMark03 score did. The P5GD2's 4335 and 4883 CPU and Memory scores also enjoyed narrow leads over the competition. The 3904 Graphics score stood out, as most P4 520 Graphics scores had hovered around 3685. The 3903 HDD score was also competitive, although we didn't take advantage of SATA RAID on this board. Doing so would've certainly improved our HDD score.

At 800 x 600 and 1,024 x 768, the GIGABYTE board held slight advantages over the P5GD2 in Halo frame rates. At 42.46fps and 40.17fps, however, the P4GD2 enjoyed an advantage over both the MSI and Intel boards. At 1,280 x

Performance Comparison

Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition) Overclock (3.56GHz
3DMark03 Build 340	5131	5161	5212	5209
PCMark04 1.2.0	4213	4703	4981	5092
CPU	4335	4875	5074	5316
Memory	4883	5150	5178	5268
Graphics	3904	3910	3945	4014
HDD	3903	3908	3976	3925
Halo				
800 x 600	42.46fps	46.12fps	46.23fps	48.57fps
1,024 x 768	40.17fps	39.94fps	41.89fps	42.79fps
1,280 x 1,024	29.24fps	28.80fps	29.43fps	29.51fps
Doom 3				
800 x 600	28.6fps	28.9fps	28.9fps	29.0fps
1,024 x 768	21.4fps	21.6fps	21.6fps	21.6fps
1,280 x 1,024	14.8fps	14.9fps	14.9fps	14.9fps

*Board includes no overclocking options.

1,024, the P5GD2 managed the fastest P4 520 Halo frame rates at 29.24fps.

When it comes to Doom 3, a tenth of a second is lot of difference. The P5GD2 posted the best P4 520 Doom 3 scores we recorded. In High Quality we managed 28.6fps, 21.4fps, and 14.8fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024.

System Specs	
Component	**Model**
Motherboard	ASUS P5GD2 Deluxe
Processor	Pentium 4 520 2.8GHz
Processor	Pentium 4 540 3.2GHz
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ Platinum Enhanced PC4200 DDR2
Video Card	128MB Chaintech NVIDIA GeForce PCX5900
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

On the GIGABYTE 8I915G Pro, we managed to get the FSB speed up to 253MHz with the P4 520 installed. The ASUS couldn't quite make it above 250MHz, but we still managed an impressive 247MHz. At this speed the processor clock was running at a brisk 3.46GHz. Our 3DMark03 score increased to 5205, and our overall PCMark04 score increased to 4964 on the strength of a 5186 CPU score and massive 5767 Memory core.

Our next processor was a P4 540 running at 3.4GHz. The 5161 3DMark03 score increased just 30 points from our last test, but it still towered above P4 540 scores from competitors.

The 4703 overall PCMark04 score, however, wasn't impressive at all. Both the MSI and Intel boards posted higher P4 540 PCMark04 scores. The 4875 CPU score was the lowest P4 540 CPU score posted, while the 5150 Memory score was just slightly faster than the competition. The 3910 Graphics score didn't improve much from our last test, but it was still above and beyond other P4 540 Graphics scores. Again, the 3908 HDD score was a little low.

At 800 x 600, we managed 46.12fps in Halo. That score fell to 39.94fps at 1,024 x 768. Both scores were just slightly behind the GIGABYTE board we looked at earlier. At 1,280 x 1,024, however, the P5GD2 posted the best P4 540 frame rates at 28.80fps. Doom 3 frame rates were still excellent, coming in at 28.9fps, 21.6fps, and 14.9fps.

We managed to overclock this board to 230MHz with the P4 540. This resulted in a processor clock speed of 3.68GHz. Compared to the 247MHz FSB we achieved with the P4 520, the lower FSB speed seemed to limit our memory performance. With the P4 540 running on a 230MHz FSB, our Memory score was about 100 points lower. Our Graphics score was also down slightly compared to our last overclock, but thanks to a strong 5513 CPU score, we managed a decent 5220 overall PCMark04 score. Our 3DMark03 score was down slightly from our last overclock to 5191.

Our final processor was the 3.4GHz Pentium 4 Extreme Edition. With this processor, we posted our best stock 3DMark03 score (5212). Our 4981 overall PCMark04 score, however, was just slightly lower than the 3.4GHz P4 EE scores posted by the Intel and MSI boards. The 5074 CPU score was a little low, as was the 5178 Memory score. Once again, however, the 3945 Graphics score was a standout compared to other 3.4GHz P4 EE scores. The 3976 HDD score was the best we've received from this board so far.

Our Halo trend continued as we averaged 46.23fps and 41.89fps at 800 x 600 and 1,024 x 768 (both below the scores posted by the GIGABYTE board). At 1,280 x 1,024, we managed 29.43fps, almost 1fps faster than the GIGABYTE board.

As always, the P5GD2 delivered the best Doom 3 scores of any 915 board. We managed 28.9fps, 21.6fps, and 14.9fps. At 1,280 x 1,024, we managed nearly 1fps better than the competition.

We don't usually get much more from our P4 EE. We did manage to overclock this processor to 209MHz, resulting in a 3.56GHz processor clock speed. We managed to increase our 3DMark03 score to 5209 and overall PCMark04 score to 5092 on the strengths of a 5316 CPU score and 5268 Memory score.

ASUS P5GD2 Deluxe	
Socket Type	**LGA 775**
Chipset	Intel 915P
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	3
PCI -E x1	2
SATA Ports	8 (4 by ICH6R; 4 by Silicon Image RAID Controller)
IDE	3 (2 for RAID)
USB Ports	8 total; 4 onboard, 2 on included bracket, header for 2 additional ports
FireWire Ports	2 (1 on board, 1 via included bracket)
LAN	Marvell 88E8053 PCI-E Gigabit LAN; integrated 802.11g
Integrated Audio	C-Media CMI9880 7.1-channel audio codec
Integrated Graphics	None
Other Features	Integrated WLAN, Post Reporter, Q-Fan2, CrashFree BIOS 2, MyLogo 2, PC Probe, Live Update Utility, Norton Antivirus
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com
Price	$199

Final Thoughts

We found the P5GD2 online for about $160, making it the most expensive 915 board we looked at. The price difference, however, is minimal considering the feature package. If you're tempted by RAID alone, this board is probably worth the money, although you'll need to invest more in additional components (PCI-E graphics card and DDR2). CPU

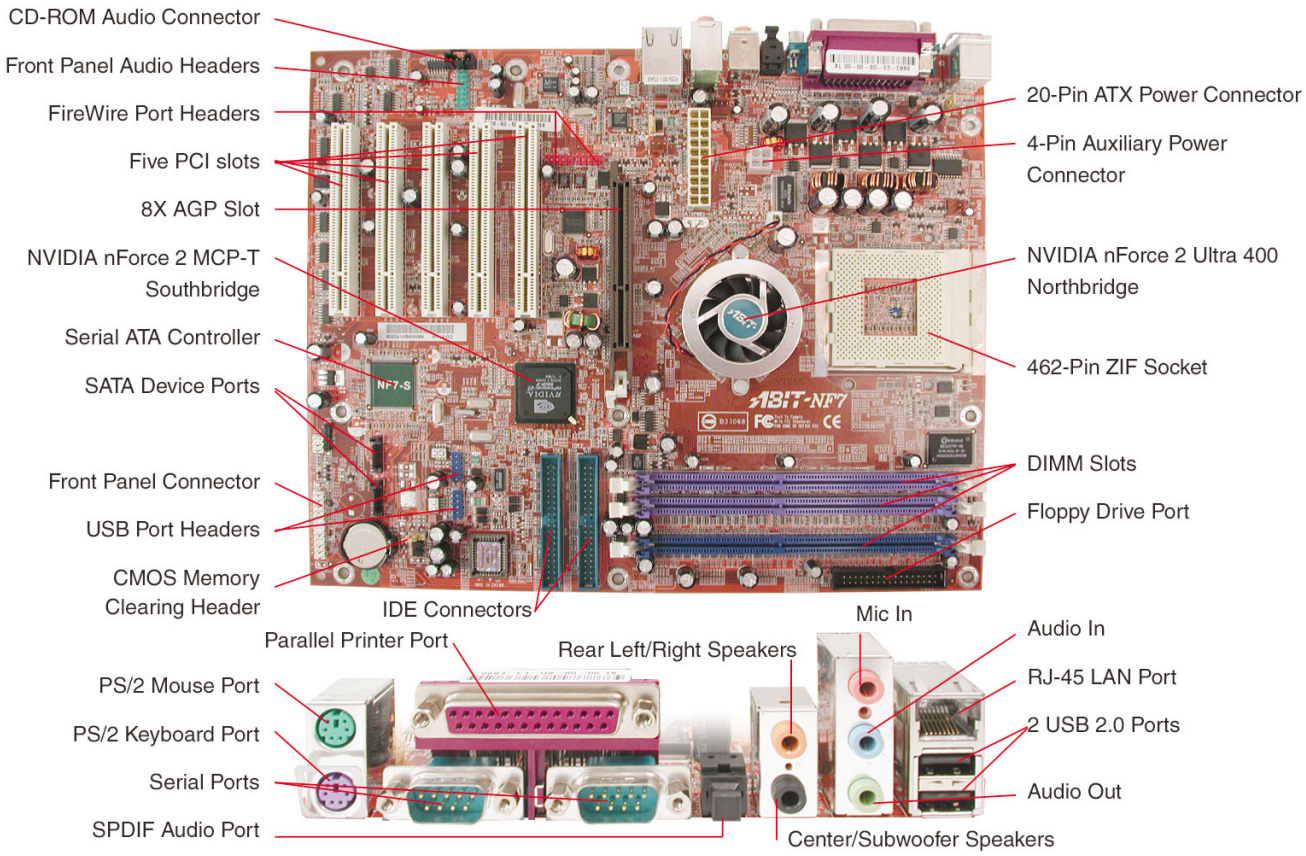
Overall Rating:

by Chad Denton

ABIT NF7-S (Version 2.0)

Layout: ATX (Socket A)

Chipset: NVIDIA nForce2 Ultra 400, MCP-T



The NF7-S is one of ABIT's most popular ATX Socket A motherboards, and for good reason: it costs less than $90 and is loaded with features and extras. The NF7-S supports Athlon XP, Athlon, and Duron processors up to 3200+, so we tested it with three of AMD's Athlon XP processors, the 2400+, 2800+, and 3200+. The NF7-S' latest BIOS update adds support for Sempron 2200+ to 2800+ processors.

Integrated Features

The NF7-S gets its guts from NVIDIA's powerful nForce2 Ultra 400 chipset, which features two independent 64-bit memory controllers that support dual-channel throughput between any two matched modules for up to 6.4GBps system memory bandwidth. The motherboard sustains processor FSB speeds of 400MHz, 333MHz, and 266MHz.

ABIT equipped the NF7-S with the Ultra 400R version of NVIDIA's chipset, which refers to the SATA RAID capability provided by the southbridge MCP (Media and Communications Processor). This motherboard supports RAID 0 for striping and RAID 1 for mirroring via the two Silicon Image-controlled Serial ATA ports.

Located just below the AGP slot, the IEEE 1394a chip supports two FireWire 400 ports with the adjacent headers. NVIDIA's MCP-T chip controls the

ABIT NF7-S (2.0)	
Socket Type	AMD Socket A
Chipset	NVIDIA nForce2 Ultra 400 + MCP-T
Processor Support	AMD Athlon XP, Athlon, Duron (400/333/266/200MHz FSB)
RAM Support	3GB DDR333/266/200 or 2GB DDR400
RAM Slots	3 184-pin DIMM slots
Graphics Bus	AGP 8X
PCI Slots 5	
SATA Ports	2 (Silicon Image; RAID 0, 1)
IDE	2 (Ultra DMA 133/100/66)
USB Ports	2 USB 2.0 (2 more optional)
FireWire Ports	2 (optional)
LAN	10/100 Ethernet
Integrated Audio	6-channel AC 97
Integrated Graphics	N/A
Other Features	Dual Channel Memory, SPDIF Out
Manufacturer	ABIT
Phone	(510) 623-0500
URL	www.abit-usa.com
Price	$87

two USB headers located above the SATA ports, which support another four USB ports.

The T of the MCP-T southbridge stands for turbo and refers to the NF7-S' support of FireWire, as well as NVIDIA's DualNet network controller and SoundStorm integrated audio. NVIDIA's SoundStorm (featured in Microsoft's Xbox) delivers the superior audio features of a standalone sound card for a fraction of the cost.

Other integrated features of the NF7-S include the Attansic ATXP1, which is a jumper-free overclocking chip. Attansic also provides the ATTP1, which is a temperature protection controller. The LAN controller is courtesy of Realtek and delivers 10/100Mbps Ethernet. Realtek also handles the integrated audio capabilities of the NF7-S with the integrated ALC650 chip. The Winbond W83627HF-AW I/O controller supports the IDE (Ultra DMA 133/100/66) and floppy ports.

Ports and Connectors

The 462-pin socket of the NF7-S is oriented so that the locking brackets are on the top and bottom of the socket. ABIT includes two iridescent pads just below the locking lugs to protect the PCB from being gouged by the heatsink clamps.

The three 184-pin DIMM sockets can handle up to 3GB of DDR 333/266/200 RAM, or up to 2GB of DDR 400 PC3200 RAM, both unbuffered and non-ECC. DIMM1 and DIMM2 are purple and located side-by-side, while DIMM3 is blue and about a quarter of an inch away from the other two sockets.

The NF7-S has a brown AGP 8X slot that is slightly offset from the PCI slots and has a locking mechanism to hold your video card in place. The slot is capable of 2.1GBps peak performance and is also AGP 4X compatible. The NF7-S' set of five PCI slots is fairly standard fare for ATX motherboards.

Two aqua IDE ports are situated below and perpendicular to the memory slots and allow for up to four hard drives or optical drives. We were pleased to see that both the IDE ports and the floppy port are keyed so that the notched IDE cable plugs only fit one way, which spares you the tedious task of figuring out which pin is Pin One. The black floppy port is beside the memory slots at the far edge of the motherboard.

The integrated Silicon Image Serial ATA controller provides for two additional hard drives at 150MBps in standard, RAID 0, and RAID 1 configurations. ABIT tried to help us out by providing a SATA diskette, but the drivers on the disk were outdated, so we downloaded new drivers from ABIT's Web site.

The NF7-S's I/O back panel includes ports for a standard PS/2 mouse and keyboard. Two serial port connectors and one parallel port connector are included for your legacy peripherals. An SPDIF Out connector provides superior digital audio. Speaking of audio, the back panel features ports for a front speaker, line-in, mic-in, center channel and subwoofer, and surround speakers for building a 6-channel audio system. The Ethernet port sits above the two external USB ports.

The NF7-S includes ports for both the 20-pin ATX power connector, and the 4-pin auxiliary connector, though the latter is largely optional for Socket A motherboard manufacturers.

An internal audio connector for the audio output of a CD-ROM drive or add-on card is adjacent to the front panel audio.

Performance Comparison				
Benchmark	Athlon XP 2400+	Athlon XP 2800+	Athlon XP 3200+	Athlon XP 3200+ OC
3DMark03 Build 340		**4775**	**4905**	**5002**	**5061 (+59)**
PCMark04 1.2.0	**3323**	**3630**	**3922**	**4150 (+228)**
CPU	3263	3484	3753	4006 (+253)
Memory	2075	2366	2693	2886 (+193)
Graphics	4446	4583	4658	4719 (+61)
HDD	4416	4420	4398	4442 (+44)
Halo				
800 x 600	39.02fps	43.95fps	46.71fps	48.2fps (+1.49)
1,024 x 768	37.01fps	40.78fps	42.98fps	42.94fps (-0.04)
1,280 x 1,024	29.40fps	30.35fps	30.99fps	30.70fps (-0.29)
Doom 3				
800 x 600	32.9fps	29.7fps	30.0fps	30.3fps (+0.3)
1,024 x 768	21.1fps	22.4fps	22.6fps	22.8fps (+0.2)
1,280 x 1,024	15.4fps	15.5fps	15.6fps	15.7fps (+0.1)

BIOS

The Phoenix Award BIOS features ABIT's SoftMenu III, which is an overclocking submenu of the CMOS Setup Utility that

gives access to the CPU frequency, Vcore, and CPU multiplier, as well as the chipset, DDR, and AGP voltage. We used the SoftMenu exclusively for our overclocking and found it, and the rest of the CMOS Utility, fairly user-friendly.

The Standard CMOS Features menu item includes basic settings and information about the hardware such as the date and time, as well as the IDE devices, floppy drives, and video card. The Advanced BIOS Features submenu includes the boot device priority, which we adjusted while installing Windows. The Advanced Chipset Features item lets you adjust the memory timings, AGP aperture size, and frame buffer size, as well as FSB and AGP spread spectrum settings. Other menu items include Integrated Peripherals, Power Management Setup, PnP/PCI Configurations, and PC Health Status, which we used to check our temps.

Additional Technologies

ABIT's ThermalGuard Technology is a hardware-based CPU temperature monitor that automatically shuts the system down if the core gets too hot. The MaxFID Technology is a feature of the NF7-S that lets users adjust the CPU's multiplier, which adds to this board's already impressive overclocking potential.

Software & Accessories

ABIT comes up short on extra software, including only Acrobat Reader, Award Flash, DirectX version 9.0b, and the LoFormat Utility.

The NF7-S includes ABIT's exclusive Serillel2 converter that lets you plug a Parallel ATA or ATAPI device into a SATA port for up to 150MBps of data throughput. The NF7-S came with an internal module that expands your peripheral ports to four USB and two FireWire.

Overclocking Performance

With ABIT's SoftMenu set to the optimized defaults, we tested the NF7-S with 3DMark03, PCMark04, Halo, and Doom 3.

The Athlon XP 3200+, with a 200MHz FSB (400MHz; 2.20GHz clock speed), 11x multiplier, and 1.65V VCore, scored 5002 in 3DMark03 and 3922 PCMarks (Overall); 3753 (CPU); 2693 (Memory); and 4658 (Graphics). We were curious about how much overclocking headroom the Athlon XP would yield, so we jumped into the SoftMenu and started tweaking the BIOS settings.

We started off with the highest stable settings that we achieved while working with the Athlon XP 3200+ on the GIGABYTE GA-7NNXP from a previous issue. After pressing DELETE to access the CMOS Setup Utility, we pressed ENTER to open the SoftMenu III Setup. Next, we changed the External Clock from 200MHz to 221MHz. We knew this would tax the system at the standard voltage, so we changed the Power Supply controller from System Default to User Define and raised the VCore from 1.65V to 1.8V.

The system loaded, but wasn't stable enough to complete 3DMark03, so we restarted the computer and entered the SoftMenu again. We dropped the External Clock to 210MHz and brought the system back to the default VCore setting of 1.65V. This time we got 3DMark03 to complete the testing cycle, but we thought we could squeeze a little more out of the board. We noted that above 210MHz, we had to boost the VCore to get the tests to run. We managed to post scores with the External Clock set to 215MHz and the VCore set to 1.75V. Next, we tried to boost the clock to 217MHz, but the system failed to complete the tests again. We were willing to bet that 216MHz was the sweet spot, and we were right. With the Athlon XP 3200+ at 2.376GHz (216MHz clock; 1.75V VCore), we managed to post 5061 in 3DMark03. We improved our PCMark04 overall rating by 228 points (4150) and managed to increase our CPU rating by 253 points (4006), while our memory and graphics scores improved by 193 (2886) and 61 (4719) points, respectively. We also tested and overclocked the Athlon XP 2400+ and 2800+. We got the 2400+ to post impressive scores with the clock set to 150MHz (up from 133MHz) and the VCore at 1.75V (up from 1.65V) for a clock speed of 2.25GHz. In fact, the 2400+ was posting scores better than the stock scores for the 2800+, which costs approximately $45 more. The 2400+ scored a 4775 in 3DMark03 at the stock settings but eked out a 4935 at the overclocked settings. The PCMark04 CPU rating went from 3263 to 3717.

System Specs

Component	Model
Component	Model
Motherboard	ABIT NF7-S
Processor	AMD Athlon XP 2400+
Processor	AMD Athlon XP 2800+
Processor	AMD Athlon XP 3200+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7200rpm 8MB cache
Optical Drive	BenQ 4x4x12x DVD+RW /16x10x32x CD-RW
Chassis	Lian Li PC-78B USB
Operating System	Windows XP Home

The 2800+ also managed to score roughly equal to the stock performance of the 3200+, which costs about $67 more. The stock 3DMark03 score was 4905, but we managed a 5014 after tweaking the settings. We were also impressed by the 342 point jump in the PCMark04 Overall rating (up from 3630), and the 3823 CPU score (up 339 points). For more scores, check out www.computerpoweruser.com.

Final Word

Having tested ABIT's NF7-S, we can recommend it to anyone looking for a solid Socket A motherboard. The board layout is good, except for the FireWire header being too close to the AGP slot.

Aesthetics were not ABIT's priority with the NF7-S as evidenced by the light brown PCB and multicolored components. Whoever said "brown goes with everything" hasn't seen the NF7-S' aqua green IDE ports, pastel purple memory slots, beige PCI slots, and dark brown AGP slot. If you're thinking of putting the NF7-S in a windowed PC, you may want to hang curtains. CPU

Overall Rating: 4 CPUs

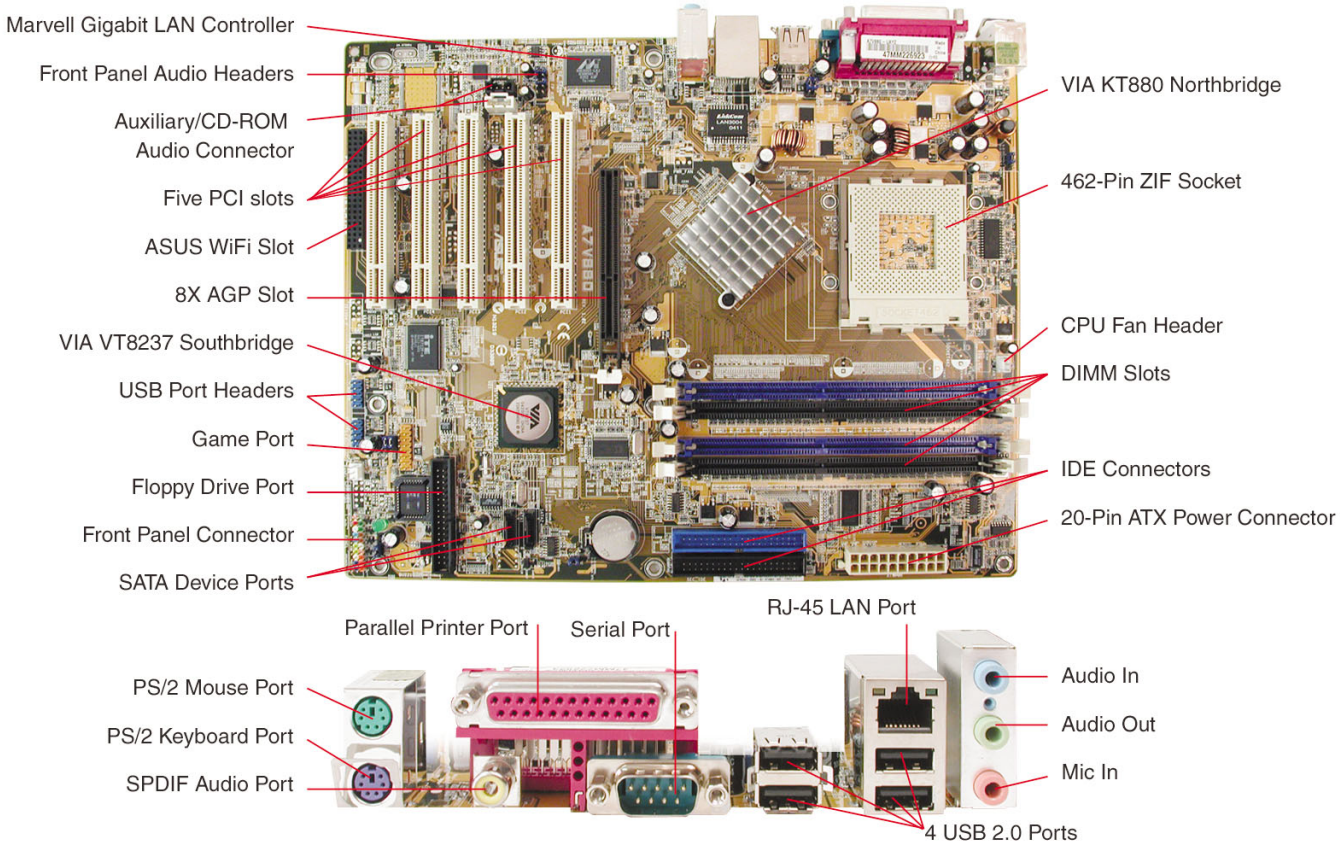
by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless, 2.5 = Absolutely Average, 5 = Absolutely Perfect

ASUS A7V880

Layout: ATX (Socket A)

Chipset: VIA KT880, VT8237



The A7V880 supports Athlon XP, Athlon, and Duron processors up to 3200+, so we tested it with the 2400+, 2800+, and 3200+ Athlon XP processors. As of this writing, ASUS hadn't listed Sempron processors as compatible with the A7V880, but the latest BIOS update (version 1004) includes AMD K7 Sempron CPU code.

Integrated Features

The A7V880 features VIA's KT880 chipset, which is billed as being comparable to the NVIDIA nForce 2 SPP, but at a much more palatable price point. The northbridge's synchronous bus architecture supports Athlon XP processors with FSB speeds up to 400MHz, AGP 4X and 8X compatibility, and DualStream64 technology. Dual-channel memory supplies up to 6.4GBps peak throughput with matched DDR400 SDRAM modules.

The VT8237 southbridge manages two dual-channel Serial ATA ports for 150MBps of data throughput between two devices. The SATA ports provide native RAID capabilities. VIA's VT8237 also manages the SoundMAX Digital Audio System, which provides 6-channel integrated audio. SoundMAX also features a DLS2 MIDI synthesizer with Yamaha DLSbyXG sound set and 5.1 Virtual Theater.

The A7V880 boasts AI NET, which features Gigabit Ethernet via the Marvell 88E8001-LKJ controller, which is adjacent to the AGP slot. The Marvell controller features the VCT (Virtual Cable Tester) net-diagnosing utility, which can detect a bad cable at up to 100 meters.

The A7V880 provides two Hi-Speed USB 2.0 headers in addition to the four ports on the I/O panel. In all, this board supports up to eight USB devices; however, FireWire support is not included.

ASUS A7V880	
Socket Type	AMD Socket A
Chipset	VIA KT880 + VT8237
Processor Support	AMD Athlon XP, Athlon, Duron (400MHz FSB)
RAM Support	4GB DDR 400/333/266
RAM Slots	4 184-pin DIMM slots
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2 (VIA 8237; RAID 0, 1)
IDE	2 (Ultra DMA 133/100/66/33)
USB Ports	4 USB 2.0 (4 more optional)
FireWire Ports	N/A
LAN	10/100/1000 Ethernet
Integrated Audio	6-channel SoundMAX Digital Audio System
Integrated Graphics	N/A
Other Features	Dual-Channel Memory, SPDIF Out, ASUS Wi-Fi slot
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com/products/mb/socketa/a7v880/overview.htm
Price	$72

Ports & Connectors

ASUS positioned the socket approximately 0.25 inches from the capacitors and nearly 0.75 inches from the northbridge heatsink and memory slots, which made it easier to remove the heatsink and CPU without taking the motherboard out of the case. This also gives you plenty of room for a larger aftermarket heatsink.

The four 184-pin memory slots can supply the A7V880 with up to 4GB of DDR 400, 333, or 266 unbuffered and non-ECC memory. The slots labeled DIMM A1 and DIMM B1 are blue, while DIMM A2 and DIMM B2 are black to make dual-channel configurations easier to implement. Because we only had two matched modules, we used the blue DIMM slots, A1 and B1.

The brown AGP slot is rated for 8X and 4X video cards and features a built-in lock. Directly below the AGP slot are five beige PCI slots that provide for plenty of expansion. Below the PCI slots, the A7V880 features a Wi-Fi slot for ASUS' Wireless LAN add-on card.

ASUS positioned the two IDE ports at the far edge of the board parallel to the memory slots. The port labeled PRI_IDE is blue and the SEC_IDE port is black. Both ports are keyed so that notched plugs will only fit one way. ASUS was kind enough to mark pin one with a white arrow in case you're using un-notched ribbon cables. The black floppy port is perpendicular to the IDE ports and toward the lower-right corner of the board (when installed in a case). We liked how these ports were positioned close to the standoff supports, so plugging them in didn't stress the PCB.

Between the floppy port and the CMOS battery, the two SATA ports support two devices for RAID 0 and RAID 1 arrays. ASUS didn't include a SATA driver diskette, so we had to explore the A7V880 support CD and create a driver disk to install our SATA hard drive.

The 20-pin ATX power connector is located at the far-right edge of the board, parallel to the memory slots. Because Athlon XP processors don't require the 4-pin auxiliary connector, ASUS left the port off the board entirely. The power LED, situated above the front panel connectors, lights green when the system is on.

ASUS included CD-ROM and Auxiliary ports for stereo audio input from a CD-ROM, TV tuner, or other audio device. The SPDIF headers allow for a digital audio module (purchased separately). To access the front-panel audio headers, you have to remove two jumper caps prior to installing the Intel-standard front-panel audio plug or separate audio plugs (if your case doesn't conform to Intel's standard).

The USB headers, labeled USB56 and USB78, are at the bottom of the board and easy to access while in the case. The A7V880 includes headers for a chassis fan and CPU fan but not for a power supply fan. Both headers are labeled on the PCB. The front-panel connectors for the hard drive LED, power LED, power switch, reset switch, and internal speaker are color coded and labeled. The motherboard manual also provides a detailed diagram of the pins and associated assignments. Headers for a game/MIDI port (labeled GAME) are adjacent to the USB headers.

Software & Accessories

ASUS included an OEM version of Trend Micro's PC-cillin 2002 antivirus software. The support CD also included Acrobat Reader, Direct X 9.0, a screen saver, and the ASUS Update utility.

The retail box includes a floppy and two IDE ribbon cables, two SATA cables, a two-port USB module, extra jumper caps, support CD, I/O shield, and manual, as well as an antistatic bag and a piece of foam to protect the motherboard. As a supplement to the manual, the A7V880 came with a list of current qualified DDR400 vendors and modules.

BIOS

The American Megatrends BIOS Setup Utility is accessible by pressing DELETE at the ASUS logo screen. The utility's menu bar features a Main, Advanced, Power, Boot, and Exit menu. The Main menu gives you access to the system time and date. You can also access the IDE device information from the Main menu. The System Information submenu provides details about your computer, such as the amount of memory installed, the CPU model and speed, and the BIOS version and date. The AI Overclock Tuner allows you to manually adjust the settings or overclock the system by percentages. We tried both with varying results.

When we tested the Athlon XP 2400+, we noticed that the CPU registered as a 1.5GHz Athlon XP 1800. We thought a newer BIOS version might solve this problem, but we already had the latest release. We went ahead and flashed the latest beta BIOS (version 1005), but this didn't fix the misidentified CPU speed. In order to get the system at the default settings, we had to adjust the CPU FSB. We used the arrow keys to select the Advanced menu and then pressed ENTER on the JumperFree Configuration option. At the Standard setting, the A7V880 was underclocking our processor to 100MHz. We changed the AI Overclock Tuner to Manual and adjusted the CPU Frequency to 133MHz. The Athlon XP 2800+ and 3200+ were recognized and

clocked properly, but our problems were only just beginning.

Overclocking Performance

It didn't take us long to figure out that this board was less than ideal for overclockers. We started by overclocking the Athlon XP 2400+. After a couple of attempts, we managed to adjust the CPU frequency from 133MHz to 148MHz, which gave us an effective clock speed of 2.22GHz and a 3DMark03 score of 4342 (up from 4174). When we raised the CPU frequency to 150MHz, Windows wouldn't load. We went back into the BIOS and brought the system down to 149MHz, but this time we were faced with the error "Windows Could Not Start Because The Following File Is Missing Or Corrupt: \WINDOWS\SYSTEM32\CONFIG\SYSTEM." We tried resetting the BIOS to the Optimized and then Default settings, but neither helped. The previous overclock attempt had apparently corrupted the system Registry. We tried to repair Windows, but the system couldn't access our computer's C: drive, which left us no choice but to reinstall Windows.

Hoping for better results, we decided to use the AI Overclock Tuner to overclock the system by percentages. We soon realized that because the board thought the CPU's native frequency was 100MHz (instead of 133MHz) a 10% "overclock" was still *underclocking* the processor. At 20% and 30%, the system wouldn't boot. The 2400+, clocked at our previous best of 148MHz (2.22GHz), scored a decent 3455 in the PCMark04 Overall category (up from 3087). The CPU Rating also jumped from 3220 to a solid 3520 for a 300-point difference. The Graphics score saw a 140-point increase, from 3534 to 3674.

We were relieved to see that the A7V880 recognized the Athlon XP 2800+ and set the proper CPU frequency. For our first overclocking attempt, we raised the CPU frequency from 166 to 176MHz, which boosted our 3DMark03 score by 79 points. Emboldened, we upped the CPU to 186MHz, which posted a 151-point increase in 3DMark03. We again tried the AI Overclock Tuner at 30%, 20%, and 10% but ended up with the same error as above. With a fresh install of Windows, we decided to call it good at 186MHz (2.325GHz). The system was stable enough to post scores in every test except for Halo's 1,280 x 1,024 timedemo. The PCMark04 CPU Rating went from 3408 to 3845 for a 437-point increase, while the Memory Rating went from 2212 to 2469 for a 257-point gain.

The Athlon 3200+ also showed up with the proper CPU frequency, but we ended up having to reinstall Windows again when we found the upper-frequency limit. At 220MHz (2.42GHz), the 3200+ scored 4643 in 3DMark03, which was 141 points better than the stock score. The overclocked 3200+ posted a PCMark04 Overall Rating of 3966 (up from 3622), a 4040 CPU Rating (up from 3713), and a 3937 Graphics Rating (up from 3801). The game benchmarks didn't see many improvements between the stock and overclocked settings. The Halo 800 x 600 and 1,024 x 768 scores actually decreased. The best improvement we saw was a 0.5fps increase in the 800 x 600 timedemo for Doom 3.

Performance Comparison

Benchmark	AMD Athlon XP 3200+	Athlon XP 3200+ OC
	This CPU is recognized as having 2.2GHz clock speed but listed as Unknown AMD CPU; PCMark recognizes it as an Athlon XP 3200 at 2.2GHz)	AI OC Tuner changed to Manual; CPU freq. Changed to 220 (2.420GHz); vcore to 1.75
3DMark03 Build 340	**4502**	**4643 (+141)**
PCMark04 1.2.0	**3622**	**3966 (+344)**
CPU	3713	4040 (+327)
Memory	2572	2830 (+258)
Graphics	3801	3937 (+136)
HDD	4414	4508 (+94)
Halo		
800 x 600	42.01fps	41.99fps (-0.02)
1,024 x 768	38.83fps	38.59fps (-0.24)
1,280 x 1,024	25.13fps	25.48fps (+0.35)
Doom 3		
800 x 600	29.3fps	29.8fps (+0.50)
1,024 x 768	21.7fps	22fps (+0.30)
1,280 x 1,024	15fps	15.1fps (+0.01)

System Specs

Component	Model
Motherboard	ASUS A7V880
Processor	AMD Athlon XP 2400+
Processor	AMD Athlon XP 2800+
Processor	AMD Athlon XP 3200+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	BenQ 4X/4X12X DVD+RW ; 16X/10X/32X CD-RW
Chassis	Lian Li PC-78B USB
Operating System	Windows XP Home

Final Word

We paid $72 for the A7V880, which made it the cheapest of the Socket A boards we tested. With dual-channel memory, SATA RAID, Gigabit Ethernet, and 6-channel audio, it's easy to see this motherboard finding its way into several Socket A systems. Features aside, the A7V880's overclocking potential leaves much to be desired. Although ASUS included the ability to boost the system by percentages, doing so shouldn't corrupt the Registry and require users to reinstall Windows (though we got really good at reinstalling Windows). If you're on a budget and don't plan to overclock, this board might be what you're looking for; otherwise, pay a few extra dollars and pick up the ASUS A7N8X-E Deluxe. For more scores, visit www.computerpoweruser.com. CPU

Overall Rating:

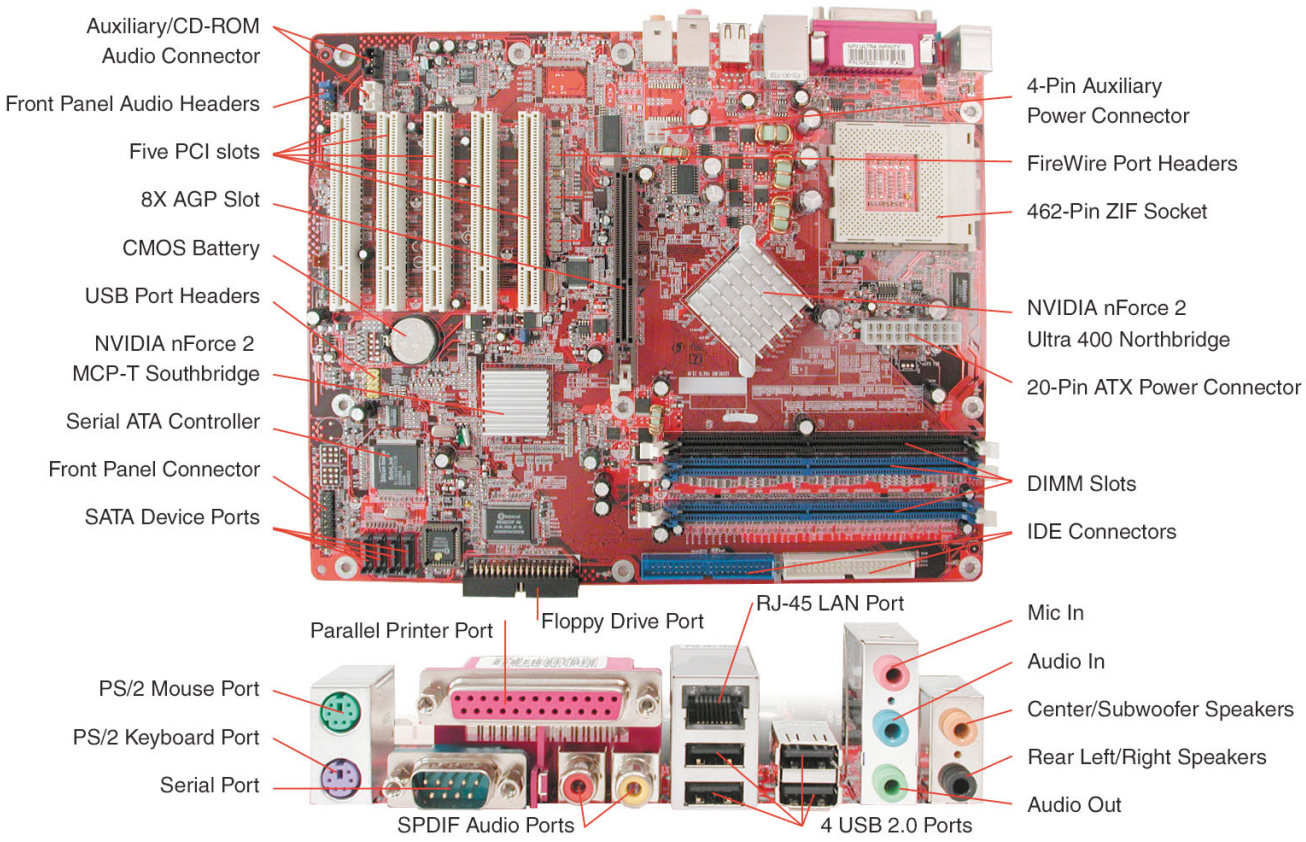
by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

DFI NFII Ultra Infinity

Layout: ATX (Socket A)

Chipset: NVIDIA nForce2 Ultra 400, MCP-T



The NFII Ultra Infinity is aimed squarely at the AMD Socket A enthusiast and supports Athlon XP, Athlon, and Duron processors up to 3200+. We tested DFI's board with the 2400+, 2800+, and 3200+ Athlon XP processors.

Integrated Features

The NFII Ultra Infinity is built on NVIDIA's premier second generation AMD chipset, the nForce2 Ultra 400, which supports a maximum 400MHz FSB speed. The NFII Ultra Infinity's dual channel support consists of two independent 64-bit memory controllers for high-speed, low-latency memory bandwidth between matched modules.

The Silicon Image SATALink controller handles the Serial ATA ports that provide 150MBps throughput for up to four devices. DFI decided to go with the Ultra 400R version of NVIDIA's MCP-T (Media and Communications Processor-Turbo) chipset rather than the Ultra 400Gb. Although the NFII Ultra Infinity loses out on Gigabit Ethernet, it does support RAID configurations between any four drives.

NVIDIA's SoundStorm integrated audio features real-time Dolby Digital encoding for the SPDIF interface, 6-channel audio, and support for two-, four-, or six-speaker sound systems. Other audio technologies, such as Microsoft's DirectSound 3D and Creative's EAX,

DFI NF II Ultra Infinity	
Socket Type	AMD Socket A
Chipset	NVIDIA nForce2 Ultra 400, MCP-T
Processor Support	AMD Athlon XP, Athlon, Duron (400/333/266/200MHz FSB)
RAM Support	3GB DDR400/333/266/200
RAM Slots	3 184-pin DIMM slots
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (Silicon Image; RAID 0, 1, 0+1, JBOD)
IDE	2 (ATA 133/100/66)
USB Ports	4 USB 2.0 (2 more optional)
FireWire Ports	3 optional
LAN	10/100 Ethernet
Integrated Audio	6-channel NVIDIA SoundStorm
Integrated Graphics	N/A
Other Features	Dual Channel Memory, SPDIF Out
Manufacturer	DFI
Phone	(510) 274-8000
URL	www.dfi.com.tw/
Price	$90

deliver realistic 3D positional audio and enhanced audio control.

The NFII Ultra Infinity features the ICS1893AF, which is a 10BASE-T and 100BASE-TX compatible network controller that offers full duplex support at 10/100Mbps. The integrated Agere FW803 chip handles the FireWire 400 support for up to three optional FireWire ports. DFI also included an optional USB interface for fifth and sixth ports.

Other integrated features of the NFII Ultra Infinity include the Realtek ALC650 chip, which supports the board's 18-bit stereo full-duplex AC'97 audio codec and combines with NVIDIA's SoundStorm for a high-quality PC audio experience comparable to that of a standalone sound card. Overclockers should take heart in the fact that DFI included the Attansic ATXP1 JumperFree Overclock Controller. Attansic also makes the AT209S, which is a PCI arbiter and clock buffer chip. Located just above the SATA ports, Winbond's W39V040AP is the NFII Ultra Infinity's BIOS chip.

Ports & Connectors

DFI situated the 462-pin ZIF socket so that the locking lugs are parallel with the top and bottom of the board (when installed in a case).

The NFII Ultra Infinity supports up to 3GB of unbuffered 184-pin memory, in DDR400, 333, 266, and 200 flavors. The color-coded slots are labeled DIMM1, DIMM2, and DIMM3. This board also supports dual-channel memory, so we put our matched modules in the blue DIMM2 and DIMM3 slots, leaving the black DIMM1 slot empty.

The AGP slot is slightly offset from the PCI slots and features a self-locking latch that holds the card to the board. At 8X, the AGP slot is capable of up to 2132MBps, while 4X cards are limited to 1,066MBps. Five beige PCI slots occupy the lower-left quadrant and supply lots of room for expansion cards.

DFI put the two IDE ports (capable of Ultra DMA Modes 3, 4, 5 and 6, for up to 133MBps data transfer rates) beside the memory slots. The port labeled IDE-P (primary) is blue, while IDE-S (secondary) is white. The black floppy port is on its side, so the ribbon cable has a low profile when installed. All three ports are notched so the included ribbon cables fit in only the proper orientation.

Silicon Image's Sil3114 Serial ATA controller can support four SATA drives for implementing RAID 0, RAID 1, RAID 0+1, and JBOD arrays. DFI included a driver disk to help with installing SATA drives. Aside from the users manual, the board also includes a RAID manual that explains RAID in-depth.

The rear-input connectors consist of a PS/2 mouse port, PS/2 keyboard port, serial port, parallel port, four USB 2.0 ports, and an RJ45 Ethernet LAN port in addition to SPDIF-in and SPDIF-out digital audio RCA jacks. The NFII Ultra Infinity also features dedicated jacks for rear, center, subwoofer, and surround speakers, as well as the usual mic, line-out, and line-in jacks.

The 20-pin ATX power connector is situated at the top of the board between the NFII Ultra Infinity's memory slots and CPU socket. The 4-pin auxiliary connector is directly adjacent to the AGP slot. DFI included a Standby Power LED, which lights when the board is powered.

Additional stereo audio input ports for a CD-ROM and Auxiliary device are to the left of the lower two PCI slots. DFI also included an SPDIF header for digital audio output. The front-panel audio connectors are at the lower left corner of the NFII Ultra Infinity, and accept a standard Intel audio connector plug.

DFI supplied headers to the right of the CMOS battery for an additional two external USB ports (sold separately). A series of three FireWire 400 connectors flank the top PCI slot and accommodate three FireWire ports (one external port included). An infrared device header is located at the bottom of the motherboard and labeled IRDA. DFI included three fan headers, one for the CPU, one for a chassis fan, and a third header for an additional fan. The front-panel connectors are in the lower-left corner of the board and feature an adjacent diagram describing the pin assignments.

Performance Comparison	
Benchmark	**Athlon XP 3200+**
	2.20GHz; 11x multiplier; 200MHz CPU Frequency
3DMark03 Build 340	5160
PCMark04 1.2.0	3968
CPU	3801
Memory	2774
Graphics	4418
HDD	4269
Halo	
800 x 600	47.93fps
1,024 x 768	44.47fps
1,280 x 1,024	31.39fps
Doom 3	
800 x 600	23.8fps
1,024 x 768	17.6fps
1,280 x 1,024	12.0fps

BIOS

The Phoenix Award BIOS is accessible by pressing DELETE during the POST. Once in the CMOS Setup Utility, we had access to the Genie BIOS Setting from the main menu. Using the arrow keys, we highlighted the Genie BIOS option and pressed ENTER, which gave us access to the CPU clock, AGP clock, CPU ratio (multiplier), DDR RAM clock, as well as the CPU, AGP, DRAM, and chipset voltages.

Back at the main CMOS Setup menu, the Standard CMOS Features submenu displays basic system information such as date, time, and the detected IDE devices, floppy drives, and video card. The Advanced BIOS Features is where we set our boot device priority when installing windows. The CMOS Setup Utility also provides access to the adjustable memory timings, AGP aperture size, and frame buffer via the Advanced Chipset Features.

Additional Technologies

DFI's Infinity series motherboards feature the BIOS Live Update feature that allows users to update the BIOS from DFI's Website in real time. You don't need a boot disk to flash this BIOS. Accessible from the CMOS Setup Utility, the CMOS Reloaded feature allows frequent tweakers to save and name successful overclocking settings.

Software & Accessories

Along with the motherboard, DFI included a black-and-white user's manual with basic installation and layout details in five languages, a Serial ATA power cable, two SATA cables, a rear-mounted FireWire bracket, IDE and floppy ribbon cables, the DFI Infinity utility CD, a Silicon Image RAID drivers diskette, and, of course, the ever important I/O shield. We were particularly impressed with the RAID manual that explains the different RAID configurations, and includes diagrams and screenshots explaining how to manage the various arrays. The box also contains an easy-to-read CMOS Reloaded manual.

Aside from the typical drivers and add-ons like Direct X and Adobe Acrobat Reader, the NFII Ultra Infinity's utility CD includes the Hardware Doctor, which is a system-monitoring application that lets you track your system temperatures, fan speeds, as well as DDR, AGP, and VCore voltages. The disc also contains the Live Update BIOS flashing application.

Overclocking Performance

As the "other" nForce2 Ultra 400 Socket A motherboard we tested, we were anxious to see how the NFII Ultra Infinity fared against the strong ABIT NF7-S. On our first outing with the 2400+, we decided to boost the FSB from 133MHz to 143MHz. The system was stable, so we tried again with an FSB of 153MHz. The system started but rebooted during the 3DMark03 benchmark. We changed the CPU voltage from Auto to Manual, and increased the setting to 1.7V. This time we posted a score, but we knew we could do better. After some more tweaking, we managed to get a stable system with the FSB at 157MHz (2.358GHz), and the CPU voltage at 1.8V. Our 3Dmark03 score was 5064, which was 194 points better than the stock performance. The overclocked 2400+ gave us some impressive increases in PCMark04, jumping from 3357 to 3925 in the Overall Rating, and going from 3286 to 3880 in the CPU Rating. Amazingly enough, the overclocked 2400+'s score beat out the stock 3200+'s scores for the PCMark04 CPU test and 3DMark03.

The 2800+ also performed well during our overclocking sessions. We got FSB from 166MHz to 185MHz for an effective clock speed of 2.313GHz. As a side note, we also mantained a stable system at 190MHz after changing the CPU voltage from Auto to 1.75V; however, this lowered our 3DMark03 scores. This happens from time to time, but we decided to run PCMark just to see how the individual components fared. The PCMark04 CPU rating jumped by 103 points, which we suspected might happen with the increased FSB.

We didn't see comparable improvements with the 3200+, but we did get the processor overclocked to 217MHz (up from 200MHz) for an effective clock speed of 2.387GHz. The 3DMark03 score rose 91 points to 5251. PCMark04 yielded a 4237 Overall Rating (up from 3968), and a 4073 CPU Rating (up from 3801). The Graphics Rating improved a meager 54 points, from 4418 to 4472. The most impressive numbers we achieved with the 3200+ were in Halo. At the 800 x 600 resolution, the 50.04fps score was the best we'd seen from our Socket A motherboards. The 800 x 600 frame rates for Doom 3 only improved nine-tenths of a frame per second, which was the most our overclocked 3200+ could muster.

System Specs

Component	Model
Motherboard	DFI NF II Ultra Infinity
Processor	AMD Athlon XP 2400+
Processor	AMD Athlon XP 2800+
Processor	AMD Athlon XP 3200+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	BenQ 4X4X12X DVD+RW /16X10X32X CD-RW
Chassis	Lian Li PC-78B USB
Operating System	Windows XP Home

Final Word

We paid $137 for the NFII Ultra Infinity, which was significantly more than the similarly equipped NF7-S from ABIT. When we compare the stock scores between the two boards, the NFII Ultra Infinity scores approximately 100 points better than the NF7-S in 3DMark03, which was especially evident in the impressive Halo frame rates. The NFII gets the edge for offering four SATA ports and more than the standard RAID options.

When all is said and done, if you need the extra SATA ports, the NFII Ultra Infinity is well worth the price. CPU

Overall Rating: 4.5

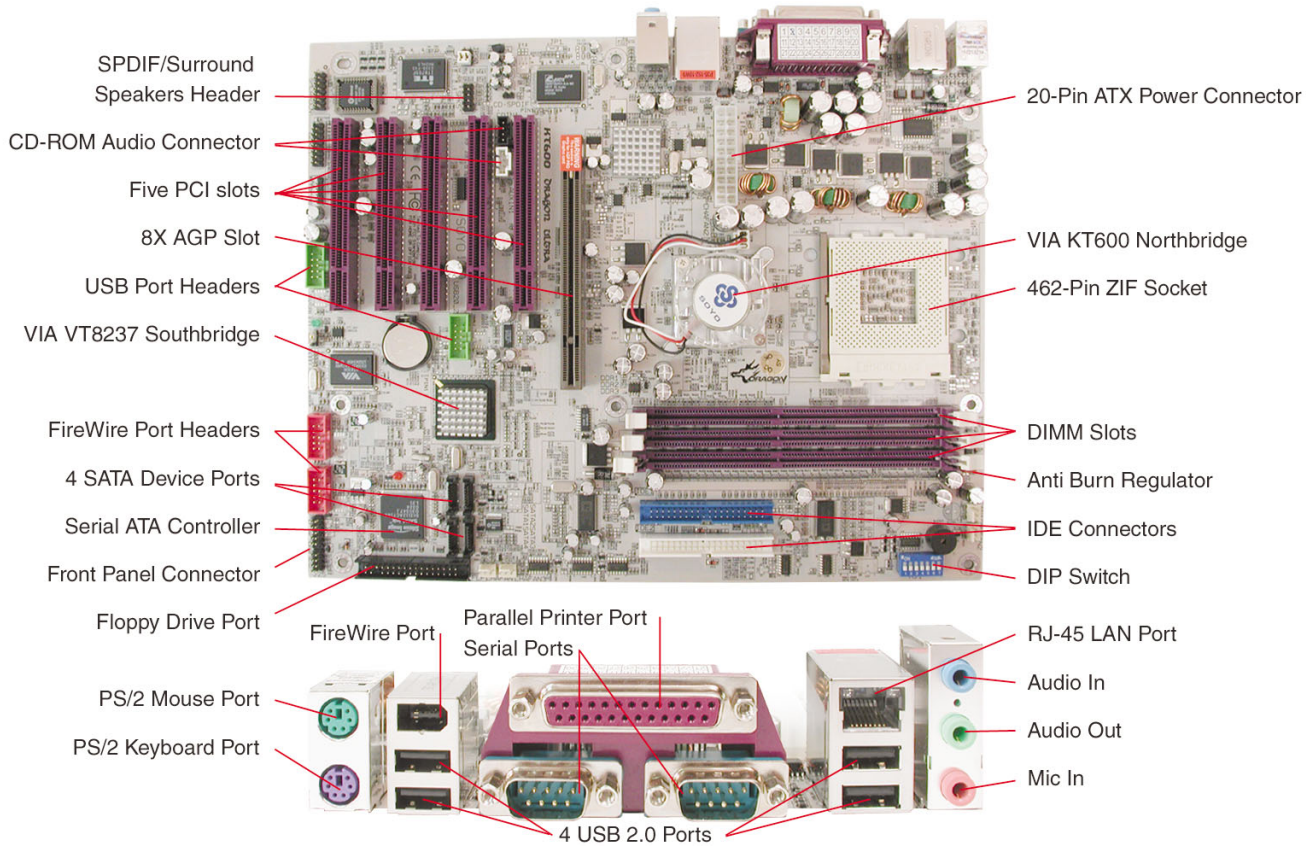
by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

SOYO SY-KT600 Dragon Ultra Platinum

Layout: ATX (Socket A)

Chipset: VIA KT600, VT8237



The SY-KT600 Dragon Ultra Platinum is a slick silver-and-purple socket A motherboard with tons of extras. Athlon, Athlon XP, and Duron processors up to 3200+ (2.2GHz) feel right at home in this motherboard. We tested the Dragon Ultra Platinum's mettle with the 2400+, 2800+, and 3200+ Athlon XP processors. As of this writing, SOYO hadn't released a BIOS update that adds support for AMD's Sempron processors.

Integrated Features

The Dragon Ultra Platinum supports FSB speeds up to 400MHz. The FastStream64 single-channel memory controller doesn't support dual-channel configurations, unfortunately. An 8X V-Link bus connects the northbridge to the southbridge for up to 533MBps of throughput.

The VT8237 southbridge features an integrated Serial ATA controller for RAID 0 and RAID 1 array capabilities and speeds up to 150MBps with two devices. The Silicone Image controller located below the four SATA ports features a red activity LED and supports an additional two devices for a total of four SATA drives. The KT600 Dragon Ultra also supports up to four Parallel ATA devices at up to 133MBps. VIA's Hyperion 4-in-1 drivers also make it easy to maintain the SY-KT600's hardware and software compatibility.

SOYO SY-KT600 Dragon Ultra Platinum	
Socket Type	AMD Socket A
Chipset	VIA KT600 + VT8237
Processor Support	AMD Athlon XP, Athlon, Duron (400/333/266/200MHz FSB)
RAM Support	3GB DDR400/333
RAM Slots	3 184-pin DIMM slots
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (VIA 8237; RAID 0, 1)
IDE	2 (Ultra DMA 133/100/66)
USB Ports	4 USB 2.0 (4 more optional)
FireWire Ports	2 optional
LAN	10/100/1000 Ethernet
Integrated Audio	6-channel CMI 8738
Integrated Graphics	N/A
Other Features	AVI PLUS 6-in-1 flash reader, SPDIF Audio card
Manufacturer	SOYO
Phone	(909) 292-2500
URL	www.soyousa.com/products /proddesc.php?id=256
Price	$115

The KT600 Dragon Ultra offers 6-channel audio from the CMedia CMI 8738 integrated audio chip. The chip features 3D positional audio for four or six speakers and includes driver support for Microsoft DirectSound3D, EAX, Linux, and BeOS. The CMI 8738 also controls the SPDIF input for digital audio from an optical drive.

The onboard BCM5705K LAN controller from Broadcom delivers 10/100/1000BASE-T Gigabit Ethernet for high-speed network applications. The LAN chip and southbridge are both adorned with matching aluminum heatsinks.

The VT6306 chip controls the two red FireWire 400 ports. SOYO also included two green USB 2.0 ports for up to four additional devices.

Left of the PCI slots, the IT8705F Super I/O chip controls the KT600 Dragon Ultra's hardware monitoring functions, fan speed controller, and the SmartGuardian function, which shuts the system down if the temperatures exceed a designated limit.

Ports & Connectors

SOYO placed two clear plastic strips beneath the locking lugs of the 462-pin socket to protect the PCB from the heatsink clips. Only a quarter of an inch separates the lugs from a row of nearby capacitors and the memory slots, but we used the two DIMM slots farthest from the CPU to give us a little extra clearance when installing and removing the CPU heatsink.

The KT600 Dragon Ultra can handle up to 3GB of PC3200 SDRAM in the three purple DIMM slots labeled DDR1, DDR2, and DDR3. All three slots are grouped together to the right of the CPU socket and to the left of the IDE ports.

The brown AGP slot handles 1.5 volt 4X and 8X graphics cards and features a removable tab to accommodate AGP Pro graphics cards. Five purple 32-bit PCI slots fill out the lower-left quarter of the board.

A blue port labeled IDE1 and a white port labeled IDE2 are situated at the far right of the board and accommodate up to four devices in Ultra DMA 100 and 133 modes.

The rear I/O panel features legacy ports for two RS-232 serial devices and one parallel-printer port. Risers on either side of the parallel and serial ports feature a total of four USB 2.0 ports, a FireWire 400 port, and an RJ-45 LAN port. The audio riser includes dedicated mic, line-out, and line-in jacks. The I/O panel's PS/2 ports make room for a 6-pin female mouse and keyboard.

SOYO left off the 4-pin auxiliary power connector (optional for socket A). The 20-pin ATX power connector is to the left of the northbridge heatsink and fan, among a forest of capacitors.

Two audio ports, labeled CDIN1 and AUXIN1, provide a direct audio feed from a CD drive or auxiliary device. The SPK5 headers accommodate the audio panel expansion bracket, which includes jacks for center channel, bass, rear left, and rear right speakers. The bracket also features digital SPDIF in/out ports and coaxial SPDIF in/out ports. Adjacent to the SPK5 headers, the JP30 jumper configures the center and bass channels depending on your speakers.

SOYO included ports for five fans, two labeled CPUFAN1 and 2, and two more labeled CHAFAN1 and 3. The northbridge chipset fan plug occupies the CHAFAN2 header. Two FireWire headers provide for two more ports, and the two USB headers can support four additional

Performance Comparison				
Benchmark	Athlon XP 2400+ 133MHz FSB (2.0GHz); CPU Voltage: Auto	Athlon XP 2800+ 166MHz FSB (2.08GHz)	Athlon XP 3200+	Athlon XP 3200+ OC
3DMark03 Build 340	**4668**	**4801**	**5031**	**N/A**
PCMark04 1.2.0	**3224**	**3475**	**3741**	**N/A**
CPU	3228	3407	3660	N/A
Memory	1948	2115	2311	N/A
Graphics	4174	4305	4396	N/A
HDD	4310	4345	4345	N/A
Halo				
800 x 600	35.66fps	42.03fps	45.58fps	N/A
1024 x 768	37.28fps	37.74fps	43.38fps	N/A
1280 x 1024	37.26fps	29.56fps	29.18fps	N/A
Doom 3				
800 x 600	22.6fps	23.8fps	28.7fps	N/A
1024 x 768	16.3fps	16.6fps	22.5fps	N/A
1280 x 1024	11.8fps	11.9fps	15.6fps	N/A

USB 2.0 devices. The headers labeled SIR-CON support compliant infrared devices. SOYO also included headers for a game port and smart card reader, labeled GAME1 and SMCARDCN, respectively.

BIOS

The Award BIOS CMOS Setup Utility is accessible by pressing DELETE at start-up. The menu items include the SOYO COMBO Feature for adjusting the system settings, Standard CMOS Features for setting the time and date, Advanced BIOS Features for adjusting the boot priority, and Advanced Chipset Features for access to the AGP & P2P Bridge Control to adjust the AGP Aperture Size and AGP Mode (4X or 8X).

We used the SOYO COMBO Feature for our overclocking. We left the System Performance at Normal throughout our overclocking and instead adjusted the CPU Frequency Mode.

Additional Technologies

The KT600 Dragon Ultra features the Anti Burn Regulator, which is a hardware circuit that works with the CPU's internal sensor to prevent the system from overheating. SOYO gives a nod to yesteryear by including a DIP (Dual In-line Package) switch for adjusting the multiplier. If you've got an unlocked CPU, you can overclock like your grandparents did.

Software & Accessories

The extras this board features are numerous, including the best third-party software package among the Socket A boards we've tested. The 8-in-1 CD includes Norton Antivirus 2003, Ghost 2003, Personal Firewall 2003; Adobe ActiveShare, Acrobat Reader, Acrobat eBook Reader, and more.

The BayOne UFO 6-in-1 memory flash reader fits into an external 3.5-inch bay or a 5.25-inch bay with the included rack adapter. The BayOne UFO module can read Smart Media, Secure Digital, Multimedia Cards, Compact Flash, and Sony Memory Stick.

Overclocking Performance

We started overclocking the 2400+ by entering the CMOS Setup Utility, selecting the SOYO COMBO Feature, and then setting the CPU Frequency Mode to Manual. This gave us the ability to adjust the processor FSB by 1MHz increments. We set the frequency to 150MHz and pressed F10 to save and restart the computer. The system wouldn't POST, so we powered down and reset the CMOS. Back in the SOYO COMBO Feature, we noticed that we could set the FSB to 150MHz from the CPU Frequency submenu rather than from the Frequency 1MHz Stepping menu, so we did that. The system loaded and was stable enough to run the benchmarks.

With an effective clock speed of 2.25GHz, we achieved a 3DMark03 score of 4743 (up from 4668), a PCMark04 Overall Rating of 3543 (up from 3224), a 3572 CPU Rating (up from 3228), a 4213 Graphics Rating (up from 4174), and a Memory Rating of 2035.

For our initial attempt with the 2800+, we set the Frequency Mode to Manual and set the FSB to 174MHz (up from 166MHz). The system wouldn't POST, so we cleared the CMOS and re-entered the BIOS. We tried several frequency levels, even manually setting the frequency to the default 166MHz FSB, but after each attempt we had to clear the CMOS to get back into the BIOS. After searching the Web, we concluded that flashing the BIOS might solve our problems, but the same issues plagued us after we successfully installed the updated BIOS.

Undeterred, we decided to overclock the 3200+. But first, we had to get the stock scores, which turned out to be a complicated endeavor. By default, the board was underclocking the processor to 1.5GHz, so we entered the BIOS and set the FSB to 200Mhz. In Windows, the screen went black during 3DMark03. Suspecting a graphics problem, we checked the Advanced Chipset Features for the AGP & P2P Bridge Control and noticed that the Graphics Aperture was set to 64MB. We set the aperture to 128MB, tried again, and got the message "Input Signal Out Of Range" in the middle of the test. Our monitor is capable of 1600 x 1200 resolutions, so we were still without a solution. A call to SOYO's technical support revealed that the KT600 chipset has known conflicts with the FX Series graphics cards. We then tried an ATI Radeon 9600XT, but encountered the same problem. We ruled out the possibility that another component was damaged by testing each separately.

System Specs

Component	Model
Motherboard	SOYO SY-KT600 Dragon Ultra Platinum
Processor	AMD Athlon XP 2400+
Processor	AMD Athlon XP 2800+
Processor	AMD Athlon XP 3200+
Memory	1GB (512x2) OCZ EL Dual-Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	BenQ 4X/4X/12X DVD+RW; 16X/10X/32X CD-RW
Chassis	Lian Li PC-78B USB
Operating System	Windows XP Home

After several restarts, driver updates, and even a fresh Windows install, we managed to get stock scores for the 3200+, but not on what we'd consider a stable system. In 3DMark03 the 2.2GHz Athlon XP scored a 5031, and a 3741 Overall Rating in PCMark04. The Halo 800 x 600 timedemo ran at 45.58fps and the 1024 x 768 resolution displayed at a decent 43.38fps. Doom 3 didn't look as good, scoring 28.7fps at 800 x 600.

Final Word

The KT600 Dragon Ultra Platinum Edition has the features, extras, and even the style to be a great motherboard. We know it can overclock as evidenced by our experience with the 2400+, but we can't recommend this board after all the problems we encountered with the 2800+ and 3200+. SOYO's technical support assured us that they are working on the FX video card conflicts, so possibly a new BIOS revision will solve the other problems, as well. For more scores, visit www.computerpoweruser.com. CPU

Overall Rating: 2.5

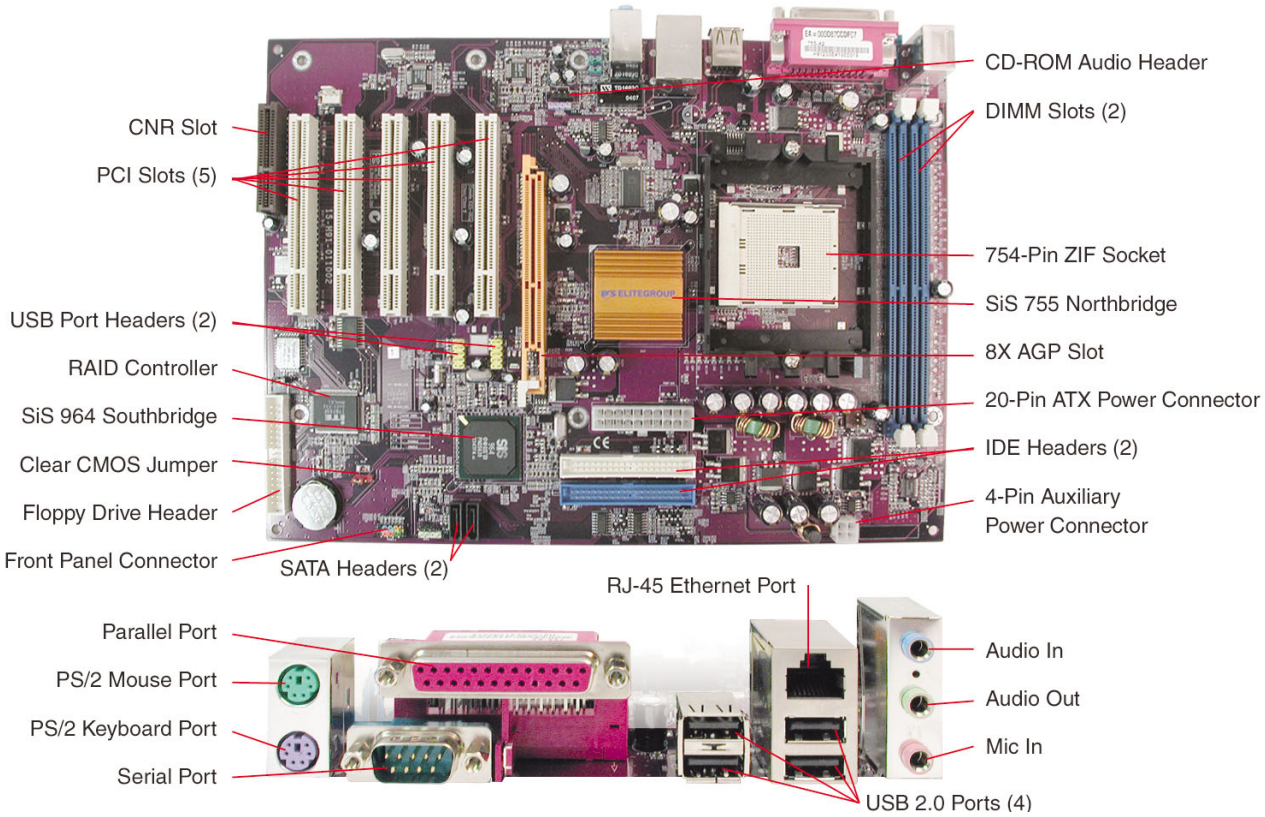
by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

ECS 755-A2

LAYOUT: ATX (Socket 754)

CHIPSET: SIS 755&964



Budget builders with little interest in performance modding will likely love the ECS (EliteGroup Computer Systems) 755-A2. It's capable of handling the latest Socket 754 AMD Athlon 64 processors; unfortunately, its horrifyingly weak overclocking abilities will frighten away virtually any performance modder.

Motherboard

The 755-A2 inspired us to resurrect some of our favorite clichés, such as "You get what you pay for" and "Close but no cigar." There's nothing inherently wrong with the 755-A2: It's a stable mobo and it didn't have any troubles with the rest of the hardware we selected. It uses a SIS 755 northbridge and SIS 964 southbridge, which is one reason this particular mobo is so inexpensive.

The lack of significant additional features is another reason we can't classify the 755-A2 as anything more than a budget or entry-level board. To its credit, the 755-A2 has two SATA headers and supports RAID 0 and RAID 1. With two SATA hard drives, you can use the 755-A2 to set up a very inexpensive striped or mirrored array.

The DIMM slots are located at the top of the board, but still sit well below the PSU. The 755-A2 supports up to 2GB of DDR400 RAM (it also supports DDR200/266/333). We can forgive ECS for not providing support for faster RAM, as DDR400 seems to be the fastest memory all other Socket 754 mobos would accept. On the other hand, we would have liked to see more than two slots. Users interested in upgrading their memory will have to plan ahead with the 755-A2.

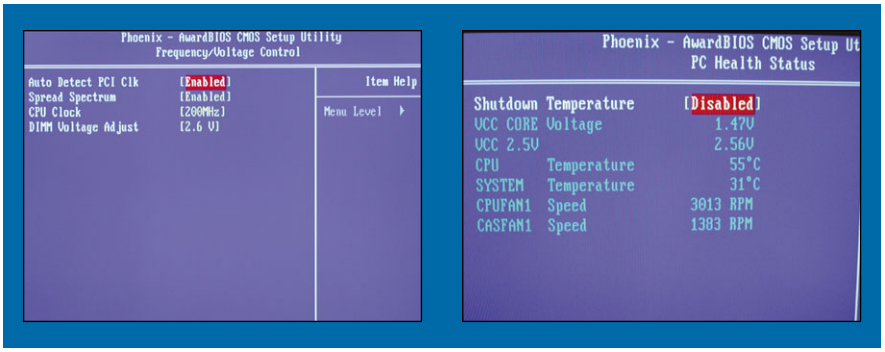
The AGP 8X slot, five PCI slots, two IDE headers, and one floppy header are all standard features that we'd expect on any mobo, but ECS only included one IDE ribbon cable and one SATA cable. There's a CNR (Communication & Networking Riser) slot, but we suspect few will use it.

ECS certainly maintained its Spartan approach to mobo building by including the bare minimum of ports on the 755-A2. Don't even think about fancy extra features like dual LAN or integrated

ECS 755-A2	
Socket Type	754
Chipset	SiS 755 (northbridge) /SiS964 (southbridge)
Processor Support	AMD Athlon 64 and Sempron processors
RAM Support	DDR up to 200/266/333/400 up to 2GB
RAM Slots	2
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2x SATA 150, RAID 0/1
IDE	2x UltraDMA 133 up to 4 devices
USB Ports	4 (USB 2.0)
FireWire Ports	0
LAN	Realtek RTL820BL 10/100 Mbps Fast Ethernet PHY
Integrated Audio	Realtek ALC655 6-Channel AC'97 CODEC
Integrated Graphics	No
Other Audio	CNR (Communication & Networking Riser) slot, PC-cillin CD-ROM included, Color Map (color-coded pin headers)
Manufacturer	ECS
Phone	(510) 226-7333
URL	www.ecsusa.com
Price	$74

Wi-Fi. Four rear USB 2.0 ports is average, and the 755-A2 does come with headers for additional USB ports. Most other common ports are noticeably absent, and ECS didn't even include headers in the event that other components (for example, the case) included a particular port. The PS/2, serial, and parallel ports arrived, but the FireWire and game ports took extended vacations from the 755-A2. Even the LAN port is a measly 10/100. The six-channel audio is delivered via an ALC655 AC'97 codec. There's no SPDIF input/output, and the 755-A2 predictably doesn't include headers for users interested in adding an SPDIF input/output.

In general, the mobo's layout is a welcome contrast to its dreary features. An orange AGP slot and northbridge heatsink complement the purple PCB. ECS also arranged the capacitors so that they don't seem to interfere with anything. We also liked that the floppy header is located away from the IDE headers; layers of tightly packed ribbon cable can quickly suffocate the air flow of a case. The CMOS jumper is conveniently placed for easy access.



Software

We didn't expect a mobo with sparse components to include a robust software package, and the 755-A2 confirmed our hypothesis. Aside from the driver CD, the 755-A2 comes with an antiquated copy of Trend Micro PC-cillin 2002. The Award WinFlash is a Windows-based BIOS flashing utility, and this could assist users who have never flashed their BIOS. Simply put, don't expect the 755-A2's software bundle to wow you.

BIOS

The ECS 755-A2 uses the common Phoenix Award BIOS that provided us with a narrow range of tinkering options. We entered the BIOS and noted all of the basic BIOS settings we expect were present. The PC Health Status section displays both CPU and system temperatures and lets users determine an emergency shutdown temperature.

We also like a couple of features in the Power Management Setup section. Enabling the Power On After Power Fail allows your computer to automatically restart following a power loss (obviously, outside power must be restored). Power Up By Alarm is disabled by default, but you can set your PC to power on automatically if you enable it.

If the 755-A2's power management options don't excite you, there's a pretty good chance the Frequency/Voltage Control section will leave you even more disappointed. Of the four paltry options, only the CPU Clock setting assisted our overclocking efforts; unfortunately, we couldn't increase the voltage fed to the CPU, which help alleviate stability problems at higher clock speeds. As we would soon discover, the sparse overclocking options in the BIOS were only the tip of the iceberg.

Stock Performance

We used three of AMD's finest Athlon 64 processors—the 2GHz 3200+ (Newcastle core), 2.4GHz 3400+ (Newcastle), and 2.4GHz 3700+ (Clawhammer)—to test the 755-A2. The board stock scores were fairly impressive as the 755-A2 held its own against more expensive boards.

We started with the Athlon 64 3200+ at its default settings (2GHz, 1.5V VCore). At 1,024 x 768 resolution, the 755-A2 returned a 5832 3DMark03 score. Our overall PCMark04 score was 3964, with 3748, 3648, 4948, and 1769

Performance Comparison

Benchmark	Athlon 64 3200+	Athlon 64 3400+	Athlon 64 3700+	Athlon 64 3700+ OC'd to 2.42
3DMark03 Build 340	5832	5903	5931	5939
PCMark04 1.2.0	3964	4632	4663	4718
CPU	3748	4432	4480	4542
Memory	3648	3829	3942	3999
Graphics	4948	5076	5075	5094
HDD	1769	1783	1838	1763
Halo				
800 x 600	57.47	55.65	56.45	57.25
1,024 x 768	48.36	49.21	50.1	50.8
1,280 x 1,024	35.7	42.63	35.63	35.83
Doom 3				
800 x 600	27.9	28.1	28.2	27.4
1,024 x 768	19.7	20.2	20.2	20.2
1,280 x 1,024	13.6	13.6	13.7	13.8

scores for CPU, Memory, Graphics, and HDD, respectively. Aside from the dreadfully low HDD score, our 3DMark03 and PCMark04 scores indicated the 755-A2 is a bargain for users who don't overclock their systems.

We also ran the 755-A2 through Halo and Doom 3 benchmarks. We used 800 x 600, 1,024 x 768, and 1,280 x 1,024 resolutions for both benchmarks. We set our video quality to High for Doom 3. At 800 x 600, we scored 57.47fps in Halo and 27.9fps in Doom 3. At 1,024 x 768, our scores dropped to 48.36fps and 19.7fps. At 1,280 x 1,024 the 755-A2 posted 35.7fps and 13.6fps. Halo is obviously playable at the default settings, but you might have to use a lower-quality setting to enjoy Doom 3. However, as our tests with the Athlon 64 3400+ and 3700+ will reveal, it's almost certain our graphics card was holding us back from achieving higher graphics scores.

Using the Athlon 64 3400+ provided a marginal 3DMark03 increase but significantly boosted our PCMark04 score. We saw our 3DMark03 score increase to 5903. Our PCMark04 score rose to 4632, a 668-point jump. Our CPU, Memory, Graphics, and HDD scores were as follows: 4432, 3829, 5076, and 1783. Again, the difference in CPU scores shows the difference a faster CPU makes.

Our game benchmarks improved slightly on most settings, but with the same graphics card, the difference was negligible. The 755-A2 returned 55.65fps, 49.21fps, and 42.63fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024 resolutions in Halo and 28.1fps, 20.2fps, and 13.6fps at corresponding resolutions in Doom 3.

We saw the smallest of gains when we swapped the Athlon 64 3400+ with the top-of-the-line Athlon 64 3700+. Our 3DMark03 score increased to 5931. Although the PCMark04 overall score only showed a negligible improvement to 4663, we experienced modest gains in both Memory (3942) and HDD (1838) scores. Our CPU and Graphics scores were 4480 and 5075, respectively.

The 3700+ only achieved small improvements in Halo and Doom 3 benchmarks. The 755-A2 scored the following in Halo: 57.25fps at 800 x 600, 50.8fps at 1,024 x 768, and 35.83 at 1,284 x 1,024. In Doom 3 we received 27.4fps, 20.2fps, and 13.8fps at increasing resolutions.

Comparing the 755-A2's stock results with the other Socket 754 mobos is a David vs. Goliath story worth telling. The 755-A2 actually beat the EPoX 8KDA3+, which is almost twice as expensive, in 3DMark03 (5832 to 5809) and tied it in PCMark04. Granted, the EPoX mobo is laden with additional features, and this alone may justify purchasing it over the ECS board, but our benchmark numbers show the 755-A2 is capable of running with the big dogs when other components are at default settings.

System Specs

Component	Model
Motherboard	ECS 755-A2
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack!Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Optorite DD0405 DVD±RW Writer (8X/4X /12X DVD+RW; 8X/4X /12X DVD-RW; 40X/24X /40X CD-RW)
Chassis	ANTEC Life Style Black Case/380W Power Supply, Model SONATA
Operating System	Windows XP Home

Overclocking

When it comes to overclocking, ECS fed us a colossal slice of humble pie. It's possible we purchased a bad board, but the 755-A2 couldn't handle more than a 2MHz increase in FSB until it wouldn't POST. Without an option to increase voltage to the VCore, we had no way to add stability and further increase the FSB. We may have technically overclocked our CPUs with the 755-A2, but any sane power user we know would sneer at a 1% performance gain. The benchmark scores of the overclocked Athlon 64 3200+ and 3400+ are available online, but our overclocked 3700+ scores show the most nominal of performance improvements.

Our 3DMark03 score improved from 5931 to 5939, an increase so small we didn't even need to break out a calculator to measure the increase. Our overall PCMark04 score of 4718 bested our stock score by 55 points, but that's still nothing to write home about. The individual PCMark04 scores also showed nominal improvement. Our scores were 4542, 3999, 5094, and 1763 for CPU, Memory, Graphics, and HDD, respectively.

As expected, we didn't experience a dramatic leap in Halo and Doom 3 performance either. Our frame rates for Halo and Doom 3, respectively, were as follows: 57.25fps and 27.4fps at 800 x 600, 50.8fps and 20.2fps at 1,024 x 768, and 35.83 and 13.8 at 1,280 x 1,024.

The 755-A2 may have passed our stock tests with flying colors, but it gets an "F" for overclocking.

Final Thoughts

Before we verbally lambast the ECS 755-A2 too much, we should reiterate that this mobo is incredibly cheap for a Socket 754 board. Aside from a few very minor design flaws, we thought the board's layout was well thought-out and aesthetically pleasing. The socket, slots, and headers are all arranged so that any particular component doesn't interfere with another one.

The 755-A2 performed admirably in all of our stock tests, proving the SIS 755/964 chipset is a viable alternative to the nForce3 250Gb and K8T800, NVIDIA, and VIA's leading Socket 754 chips. Anyone interested in performance on a purely default basis will be able to save a bundle of money without experiencing noticeable decrease in performance.

Overclockers need to look elsewhere for a mobo to satisfy their cravings, but the 755-A2 should please any budget-builder interested in a solid mobo that doesn't cost too much. CPU

Overall Rating: 2.5

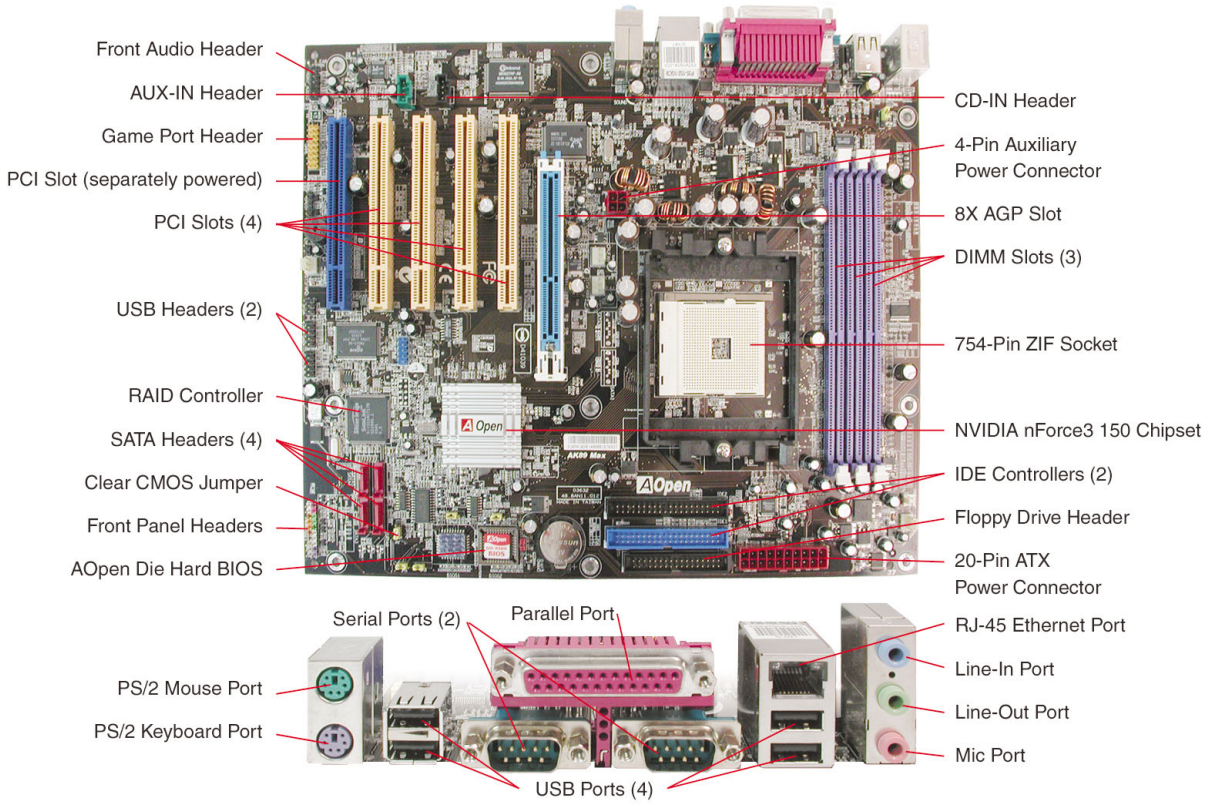
by Vince Cogley

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

AOpen AK89 Max

LAYOUT: ATX (Socket 754)

CHIPSET: NVIDIA nForce3 150



We knew that AMD Athlon 64 CPUs aren't known for having a tremendous amount of headroom, which is the telltale sign of a good overclocking processor, but we had no idea we could only squeeze a few extra MHz out them with the ECS 755-A2 motherboard. (See previous article.) With several other Socket 754 mobos at our disposal, we hoped the problem lay with the motherboard and not the CPUs.

AOpen's AK89 Max confirmed our suspicions that the ECS 755-A2 was simply not a good mobo for overclocking.

Motherboard

The AK89 Max is the high-end version of AOpen's AK89 family. As we expected, the AK89 Max features an inspiring number of features compared to the 755-A2. The socket is located near the middle of the board, well away from the power supply and other typically hot components. Three DIMM slots are situated at the top of the board and support up to 2GB DDR400 RAM or up to 3GB DDR333/266 RAM. If you have 3GB DDR400 RAM lying around, you'll have to decide between speedier memory and more memory.

The AGP slot is a sliding lock instead of one that automatically snap-locks when an AGP card is securely in the slot. Of the five PCI slots on the AK89 Max, one slot receives power separately. Power-hungry PCI cards will be right at home in this slot without siphoning power from cards using the other four slots.

If your case's chassis has a number of rear bracket mounts, the AK89 Max's additional ports will make good use of them. Two additional USB 2.0 ports, two FireWire 400 ports, a game port, and SPDIF output/inputs are included.

The AK89 Max has four SATA headers to deliver healthy dose of RAID goodness. With four SATA headers, RAID junkies will be able to setup a RAID 0+1 configuration for both striped and mirrored arrays. AOpen only included one SATA cable, so you'll have to purchase three more if you want a RAID 0+1 configuration. Two IDE headers accept up to four IDE devices, and there is one floppy disk drive header. With so many ports and headers, the AK89 Max requires an expansive case with plenty of drive bays

AK89 Max	
Socket Type	754
Chipset	NVIDIA nForce3 150
Processor Support	AMD Athlon 64 and Sempron processors
RAM Support	DDR400 up to 3GB
RAM Slots	3
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4x SATA 150, RAID 0/1/0+1
IDE	2x UltraDMA 133 up to 4 devices
USB Ports	6 (USB 2.0)
FireWire Ports	Up to 3
LAN	Realtek Gigabit Ethernet
Integrated Audio	Realtek AC-97 5.1-channel codec
Integrated Graphics	No
Other Features	SilentTek, EzClock, EzSkin, DieHard BIOS
Manufacturer	AOpen
Phone	(888) 972-6796
URL	www.aopen.com
Price	$111

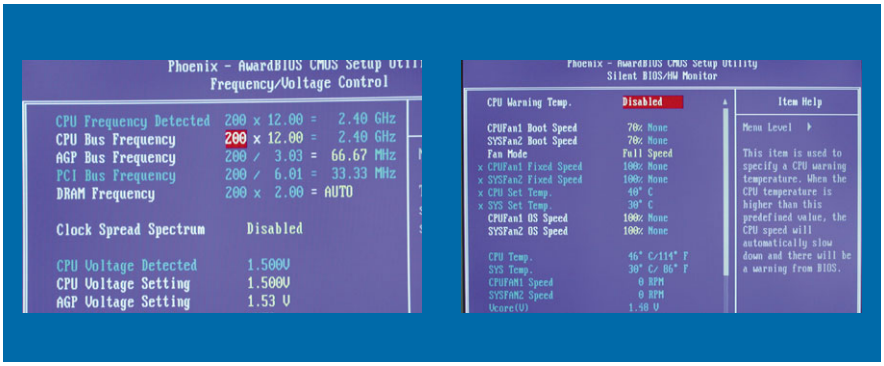
and rear-bracket mounts to fully utilize all of the mobo's features.

In addition to the AK89 Max's flashy ports, the standard fare is there, too. The rear panel has PS/2 ports, four USB 2.0 ports, a parallel port, two serial ports, a Gigabit Ethernet port, and audio ports. (The AK89 Max has integrated 5.1 audio.)

Those not familiar with NVIDIA's nForce3 150 chipset will probably notice a single chipset replaces the traditional northbridge/southbridge. The nForce3 150 chipset is sandwiched between the PCI slots and dual BIOS. The silver heatsink that sits atop the nForce3 150 chipset adds a flair to the mobo's overall appearance.

We didn't have too many complaints about the AK89 Max's physical layout, but the IDE headers, floppy disk drive header, and 20-pin ATX power connector are all claustrophobically huddled together near the right edge of the board. Two ribbon cables didn't make a huge mess, but you'll have to do some cable management if you have a case window.

All of the front panel headers are color coded, but we still recommend reading through the AK89 Max's users manual before connecting any wires.


Phoenix - AwardBIOS CMOS Setup Utility
Frequency/Voltage Control
CPU Frequency Detected 200 x 12.00 = 2.40 GHz
CPU Bus Frequency 200 x 12.00 = 2.40 GHz
AGP Bus Frequency 200 / 3.03 = 66.67 MHz
PCI Bus Frequency 200 / 6.01 = 33.33 MHz
DRAM Frequency 200 x 2.00 = AUTO
Clock Spread Spectrum Disabled
CPU Voltage Detected 1.500V
CPU Voltage Setting 1.500V
AGP Voltage Setting 1.53 V
Phoenix - AwardBIOS CMOS Setup Utility
Silent BIOS/HW Monitor
CPU Warning Temp. Disabled
Item Help

Software

In addition to the drivers, AOpen included some useful software tools for beginning modders. EzClock is a Windows-based overclocking utility that lets users adjust their CPU, graphics, PCI bus, and memory without entering the BIOS.

WinBIOS is a similar program in that it lets users adjust their BIOS settings in a Windows environment. Again, this program should find greatest appeal among fledgling modders who are comfortable with Windows.

EzRestore is an instant system restoration utility, and EzSkin lets users download skins from AOpen's Web site for the Vivid BIOS and Open Jukebox.

Norton Antivirus 2003 rounds out the AK89 Max's software offerings and is included on a separate CD.

BIOS

After our disappointment with the 755-A2's locked CPU VCore, we immediately investigated this matter with the AK89 Max and were happy to discover it allowed us to adjust our CPU's voltage. Unfortunately, we could only boost the voltage to a maximum of 1.550V, an increase of 0.05V. However, we could jump the FSB 25% from 200 to 250MHz, and an unlocked multiplier allowed us to adjust the multiplier as high as a ludicrous 25X. If you dare attempt setting your multiplier to 25X, we envy your appetite for destruction.

The AK89 Max's BIOS has an above average range of settings to help prevent you from barbequing your favorite components. SilentTek Noise Reduction Technology regulates system fans so they can run at lower rpms to reduce PC noise. OverHeat Protection is an especially handy feature that overclockers will welcome as a reliable fail-safe.

We really liked the AK89 Max's DieHard BIOS, which can protect your BIOS from a virus attack. Although we didn't want to test the DieHard BIOS in the event of a faulty BIOS flash, we presume you could use it to recover your BIOS (and subsequently, your mobo) after a failed BIOS flash.

Stock Performance

To test the AK89 Max, we saddled the same cadre of AMD Athlon 64 processors to the mobo socket and ran the mobo through our benchmark obstacle course consisting of 3DMark03, PCMark04, Halo, and Doom 3. We used default settings for the FSB and RAM speed.

Performance Comparison				
Benchmark	AMD Athlon 64 3200+	AMD Athlon 64 3400+	AMD Athlon 64 3700+	AMD Athlon 64 (2.53 O/C) 3700+
3DMark03 Build 340	5800	5892	5904	5961
PCMark04 1.2.0	3959	4579	4610	4878
CPU	3754	4441	4455	4715
Memory	3643	3834	3932	4159
Graphics	4832	4910	4937	4962
HDD	4345	4345	4372	4368
Halo				
800 x 600	52.88	55.86	56.47	58.77
1,024 x 768	48.46	49.87	50.24	53.81
1,280 x 1024	34.91	35.14	35.24	36.69
Doom 3				
800 x 600	26.7	27.4	28.4	28.6
1,024 x 768	20.1	19.8	20.3	20.4
1,280 x 1,024	13.8	13.7	13.6	13.6

Much to our chagrin, the AK89 Max turned in scores slightly lower than the less expensive ECS 755-A2. Although the difference was negligible in most cases, varying by about 30 points at most, the ECS 755-A2's 3DMark03 and PCMark04 scores bested the AK89 Max in several tests, with one noteworthy exception.

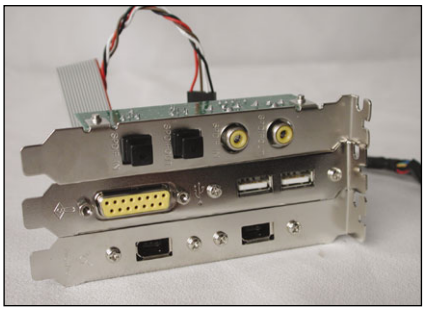
Our stock test with the 2GHz Athlon 64 3200+ helps illustrate our findings. The AK89 Max scored 5800 in 3DMark03 and 3959 in PCMark04. CPU, Memory, Graphics, and HDD scores were 3754, 3643, 4832, and 4345, respectively. By comparison, the 755-A2 posted a 5832 in 3DMark03 and a 3964 in PCMark04. The 755-A2's CPU, Memory, Graphics, and HDD scores were 3748, 3648, 4948, and 1769, respectively. Notice the CPU and Memory scores were nearly identical, and there was only slight variance in the Graphics score. But the AK89 Max embarrassed the 755-A2 with an HDD score that was 2576 points higher.

Scores in Halo and Doom 3 were also close. In Halo, the AK89 Max scored 52.88fps at 800 x 600, 48.46fps at 1024 x 768, and 34.91fps at 1280 x 1024. At the same resolutions in Doom 3 (High Quality setting), we received 27.2fps, 20.1fps, and 13.8fps.

Next, we swapped the 3200+ for the swifter 2.4GHz 3400+. Almost all of benchmark results received a nice boost

System Specs

Component	Model
Motherboard	ASUS K8V
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Optorite DD0405 DVD±RW Writer (8X/4X/12X DVD+RW, 8X/4X/12X DVD-RW, 40X/24X/40X CD-RW)
Chassis	ANTEC Life Style Black Case with 380W Power Supply, Model SONATA
Operating System	Windows XP Home



from the extra processing power. With the 3400+, the AK89 Max scored 5892 in 3DMark03. Our PCMark04 leapt over 400 points to 4579, thanks in part to an almost 700-point climb in the CPU score. The Memory, Graphics, and HDD scores were 3834, 4910, and 4345.

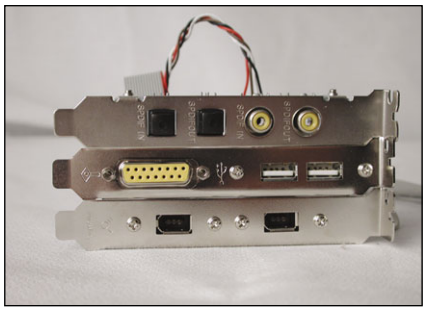
Our game benchmarks were slightly better with the 3400+, but the improvement was not quite as impressive as our higher PCMark04 score. The AK89 Max posted 55.86fps, 49.87fps, and 35.14fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024, respectively. At the same resolutions, our Doom 3 scores were 27.4fps, 19.8fps, and 13.7fps.

The fastest processor of the lot, the 3700+, also helped our score, but at a cost of $200. The 3700+ helped the AK89 Max score 5904 in 3DMark03 and 4610 in PCMark04. With CPU, Memory, Graphics, and HDD scores of 4455, 3932, 4937, and 4372, respectively, we also didn't think any individual system component received a major performance upgrade from the 3700+.

In Halo, the AK89 Max's scores were 58.77fps at 800 x 600, 53.81fps at 1024 x 768, and 36.69fps at 1280 x 1024. The 3700+ also helped our Doom 3 results, but only slightly. Our scores were 28.6fps at 800 x 600, 20.4fps at 1,024 x 768, and 13.6fps at 1,280 x 1,024. Although you'll be able to squeeze a small amount of juice out of the AK89 Max with the 3700+, it's difficult to ignore the 3400's balance between performance and price.

Overclocking

The AK89 Max had a veritable cornucopia of extra features compared to the 755-A2, but it was also more expensive. Luckily, our overclocking results helped tip the scales in favor of the AK89 Max.



The 3700+ turned out to be the worst overclocking CPU among the three, but we were still able to nudge its clock speed up to 2.53GHz with a 1.550V VCore, a 5% improvement. By comparison, we rocketed the 3200+ to a stable 2.28GHz, a 14% increase. Benchmark results for the overclocked 3200+ and 3400+ (overclocked to 2.54GHz) are available in our online chart.

Our overclocked 3700+ saw a modest increase in 3DMark03 (5961) and a substantive improvement in PCMark04 (4878). With the exception of our HDD score (4368), every individual PCMark04 score also improved. The AK89 Max's 4715 CPU score was a 260-point gain while its 4159 Memory score was a similar increase. The Graphics score, 4962, was negligible improvement.

Overclocking the 3700+ helped our Halo score by a few frames per second. The AK89 Max scored 58.77fps, 53.81fps, and 36.69fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024 resolutions, respectively. We noticed an even smaller improvement in Doom 3 performance with 28.6fps at 800 x 600, 20.4fps at 1,024 x 768, and 13.6fps at 1,280 x 1,024.

Final Thoughts

If you have to have NVIDIA's latest chipset for Socket 754 mobos, the nForce3 250Gb, you'll want to pass on the AK89 Max. However, that may not necessarily be the best idea. It overclocked well and rivaled stock benchmark results from more expensive nForce3 250Gb boards. Kudos to AOpen. CPU

Overall Rating: 4.5 CPU

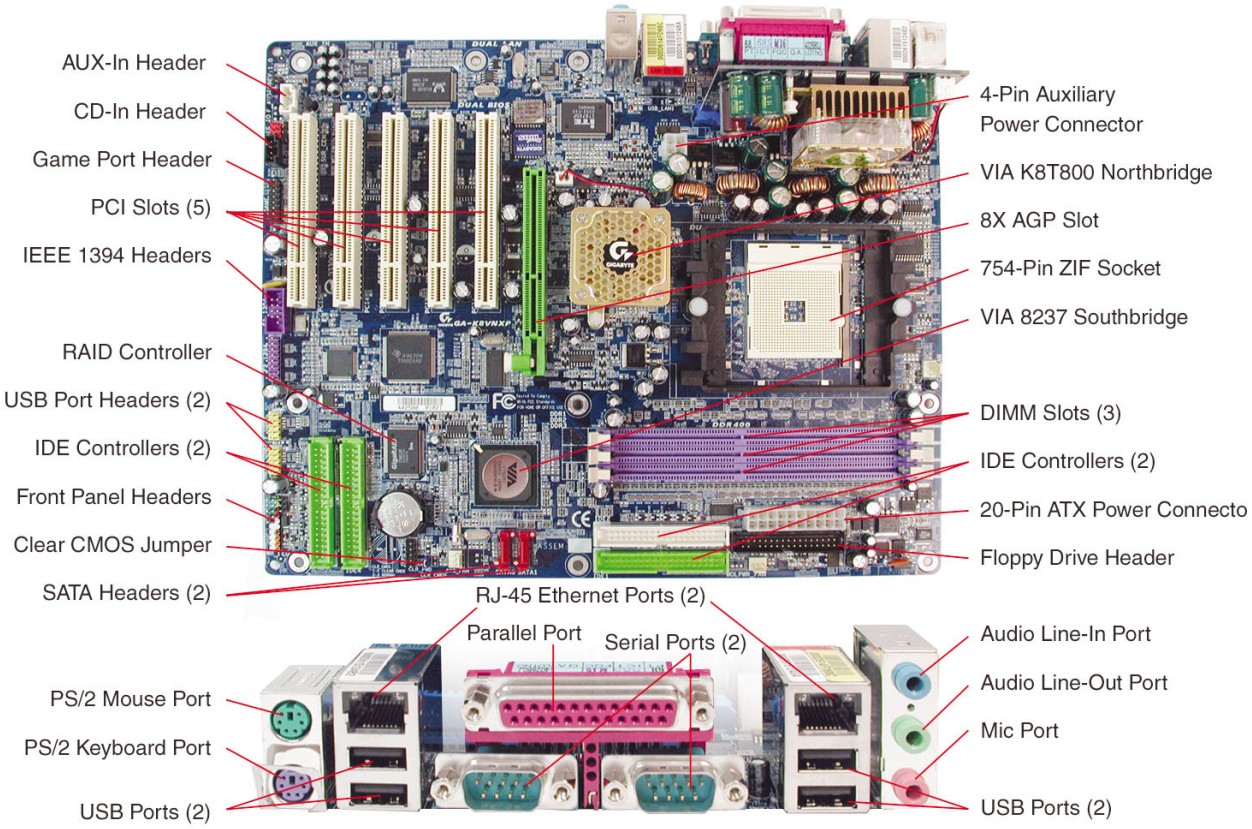
by Vince Cogley

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

GIGABYTE GA-K8VNXP

LAYOUT: ATX (Socket 754)

CHIPSET: VIA K8T800/8237



In the Socket 754 mobo arena, NVIDIA and VIA have emerged as the two fiercest competitors. NVIDIA's latest offering, the nForce3 250Gb, squares off against VIA's K8T800. GIGABYTE's GA-K8VNXP wields the VIA K8T800/8237 chips and a host of additional features, poising it as one of the leading VIA-based Socket 754 boards. As a result, we selected it as one of two motherboards to represent the K8T800/8237 chipset.

Motherboard

The GA-K8VNXP helped itself to seconds on its way through the feature buffet line. The first intuitive item you'll likely see is a separate, attachable daughter card. It slides into a slot that looks like a miniature ISA slot, located between a gaggle of capacitors and the GA-K8VNXP's side ports. The daughterboard's purpose is twofold: First, it combines with the motherboard to create the K8 DPS (Dual Power System), which provides a 6-phase power circuit, producing a more stable power supply for the CPU than conventional 3-phase designs. With the daughter card included, the GA-K8VNXP starts off on the right foot.

The GA-K8VNXP doubled up in a number of other categories, too. Like the AOpen AK89 Max; we think the DualBIOS technology included on this mobo is an excellent feature. Failed BIOS updates no longer need to reduce a mobo to a useless pile of metal, silicon, and PCB. Home networking experts will enjoy the GA-K8VNXP's dual LAN ports, although only one of them boasts gigabit speeds. We were probably the least impressed with GIGABYTE's so-called "dual RAID" feature. We'll delve into this further a little later.

We couldn't find too many faults with the GA-K8VNXP's physical design. One of its greatest assets is that fans in just the right places make this mobo one of the best we've seen for maximizing air flow. The daughter card slot is perfectly placed so that its fan circulates air and remains away from cables and other items that add extra clutter. The CPU socket is located at an acceptable distance from the power supply, and an active northbridge fan offers additional

cooling power. For all the pin headers for the extra ports, the GA-K8VNXP also doesn't look like it will suffer from tangled cables near the bottom of a case's chassis. We also liked that there were a few extra headers to install extra system fans.

While there were no grievous design errors, we may have opted for different placement of some items. Our first immediate concern was only a few air molecules separated a capacitor from the heat spreader on one of our memory modules. When we tried to correct this problem by relocating the RAM stick to the far right DIMM slot, our benchmark scores took such a hit that we decided to take our chances with the too-friendly capacitor.

A missing Clear CMOS jumper was another unpleasant surprise that left us scratching our heads. Instead, GIGABYTE expected us to remove the GA-K8VNXP's battery for 30 seconds and reinsert it.

We also would have preferred to break up the 20-pin ATX power connector, floppy header, and two IDE headers that are clustered together near the DIMM slots; GIGABYTE could have included round cables instead of clumsy ribbon cables, too.

The board scores points for treating us to a few tasty I/O options, including a FireWire 800 jumper. Two additional USB 2.0 ports accompany the two FireWire ports on the rear mounting bracket, bringing the GA-K8VNXP's USB port total to six. Another rear mounting bracket provides additional outputs for the mobo's 6-channel integrated audio capability. One output powers a center-channel speaker and subwoofer, and the other drives two rear channel speakers. An SPDIF and RCA outputs accompany the speaker outputs on this bracket.

The side I/O ports were standard, but the dual Ethernet ports are a nice touch. We'll settle for two Ethernet ports, but it would have been nice if the second port would have also supported Gigabit Ethernet. The other usual suspects make their regularly scheduled appearances: PS/2, parallel, two serial, three audio, and four USB 2.0 ports accompany the Ethernet ports. Overall, GIGABYTE did an exceptional job providing a lot of ports on the GA-K8VNXP.

This mobo probably has the strangest RAID options we saw on our family of Socket 754 boards. Two SATA ports let you easily set up a striped (RAID 0) or mirrored (RAID 1) array, but GIGABYTE gives you more RAID options with four IDE headers and a GigaRAID controller. With this particular setup, you can make a RAID 0, 1, or 0+1 array with ATA133 hard drives. (JBOD is also available).

Software

Whether you like GIGABYTE's included software bundle hinges on your feelings toward Window-based BIOS utilities and Symantec. Beginning overclockers will probably appreciate EasyTune4, which lets you overclock your CPU in a Windows environment.

@BIOS is a Windows-based BIOS-flashing utility and should be slightly more useful, as BIOS updates help users with default and overclocked settings alike. Between @BIOS and the GA-K8VNXP's dual BIOS, we think the GA-K8VNXP is the best Socket 754 mobo for BIOS-flashing.

Norton Internet Security 2003 is an outdated version of Symantec's security software suite, but some still prefer it to NIS 2004. Norton AntiVirus and Norton Personal Firewall will probably be the two most frequently used applications in the suite, but we think better AV software and firewalls are out there.

BIOS

We would have liked to see GIGABYTE include a few more BIOS options on the GA-K8VNXP. For starters, there are dreadfully few options in the PC Health Status Menu. The CPU Smart FAN Control is a good feature, but you can't configure the GA-K8VNXP to automatically shut down your PC if the CPU or system temperature exceeds a user-defined limit. System fan failure and CPU alarms help a little, but overclockers will be on their own to keep temperatures within acceptable ranges.

The Frequency/Voltage Control also provides scant options for overclocking. You can adjust the FSB and CPU Voltage, but it's best to simply leave the other options on Auto. The multiplier is completely locked; we couldn't even reduce it below default settings. AGP, DIMM, and chipset voltage controls are also locked. It wasn't a tragedy that we didn't have much control over the voltage delivered to various components, but we wished GIGABYTE would have given us the freedom to adjust our RAM timings.

Stock Performance

We encountered big problems when we installed our OCZ Gold Limited Edition RAM into DIMM slots 2 and 3 to avoid the potential problem our friendly capacitor might cause. Our 3DMark03 score was a full 200 points lower than any other Socket 754 mobo using AMD's Athlon 64 3200+ processor. At first, we thought that the GA-K8VNXP may just be a bad 3DMark03 performer, but we solved the riddle when we ran PCMark04. The pitiful 2368 Memory score hinted something was awry with our RAM. We moved one memory module from DIMM slot 3 over to slot 1, and the GA-K8VNXP jumped to life, posting much better scores in 3DMark03 (5801) and PCMark04

Performance Comparison

Benchmark	AMD Athlon 64 3200+	AMD Athlon 64 3400+	AMD Athlon 64 3700+	AMD Athlon 64 3700+ (2.54GHz O/C)
3DMark03 Build 340	5592/5801	5822	5872	5884/5914/5908
PCMark04 1.2.0	3705/3989	4521	4580	4636/4737/4755
CPU	3643/3758	4399	4457	4528/4675/4670
Memory	2368/3641	3559	3646	3729/3805/3827
Graphics	4516/4651	4647	4667	4690/4716/4706
HDD	4539/4555	4517	4545	4544/4518/4525
Halo				
800 x 600	60.51	51	54.67	55.3/55.91/56.72
1,024 x 768	51.15	47.77	49.49	50.26/49.67/51.23
1,280 x 1024	35.59	34.93	35.38	35.48/35.19/35.89
Doom 3				
800 x 600	27.1	27.2	28.3	27.4/28.4/28.5
1,024 x 768	20.1	20.2	20.3	20.3/20.3/19.9
1,280 x 1024	13.7	13.8	13.6	13.8/13.6/13.8

(3989). The GA-K8VNXP scored 3758 in the CPU test, 3641 in the Memory test, 4651 in the Graphics test, and an impressive 4555 in the HDD test.

Once we solved our RAM problem, we ran Halo and Doom 3 benchmarks with the GA-K8VNXP/Athlon 64 3200+ combo. In Halo, the mobo scored an outstanding 60.51fps at 800 x 600, 51.15fps at 1,024 x 768, and 35.59fps at 1,280 x 1,024. These Halo results were certainly anomalous, as no other processor (even the overclocked 3700+) came close to touching these numbers. The GA-K8VNXP returned to normalcy in Doom 3 with 27.1fps at 800 x 600, 20.1fps at 1,024 x 768, and 13.7 at 1,280 x 1,024.

Next, we swapped the 3200+ for the 2.4GHz 3400+, and the GA-K8VNXP responded accordingly. Our 3DMark03 score improved to 5822. The mobo scored 4521 in PCMark04, posting scores of 4399, 3559, 4647, and 4517 in CPU, Memory, Graphics, and HDD individual tests, respectively.

Based on the tests of our other mobos, we weren't surprised that our fps dropped when we ran Halo with the 3400+. At 800 x 600, the GA-K8VNXP dropped to 51fps. It scored 47.77fps at 1,024 x 768 and 34.93fps at 1,280 x 1,024.

Despite a 400MHz increase in clock speed, our Doom 3 scores barely budged. With the 3400+ the GA-K8VNXP returned the following Doom 3 results: 27.2fps, 20.2fps, and 13.8fps at 800 x 600, 1,024 x 768, and 1,280 x 1,024.

The 3700+ helped our scores, but again, improvement was only marginal. The GA-K8VNXP posted a 5872 in 3DMark03 and a 4580 in PCMark04. The mobo scored well in individual PCMark04 tests too, scoring 4457 in the CPU test, 3646 in the Memory test, 4667 in the Graphics test, and 4545 in the HDD test.

In Halo, the GA-K8VNXP delivered 54.67fps at 800 x 600, 49.49fps at 1,024 x 768, and 35.38fps at 1,280 x 1,024. In Doom 3, the 3700+ helped us reach 28.3fps at 800 x 600, 20.3fps at 1,024 x 768, and 13.6fps at 1,280 x 1,024.

Overall, we were pleased with GA-K8VNXP's stock performance. Our PCMark04 Graphics score was slightly lower than its competitors, but the GA-K8VNXP easily beat the competition in the HDD test. Changing CPU's didn't make a great amount of difference.

GA-K8VNXP	
Socket Type	754
Chipset	VIA K8T800/8237
Processor Support	AMD Athlon 64 and Sempron processors
RAM Support	DDR400 up to 3GB
RAM Slots	3
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2x Serial ATA, RAID 0/1
IDE	4x ATA 133 up to 8 Devices, RAID 0/1/0+1/JBOD
USB Ports	6 (USB 2.0;4 rear)
FireWire Ports	2
LAN	Realtek 8110S Gigabit Ethernet controller, Realtek 8201 PHY LAN chip (10/100)
Integrated Audio	Realtek 6.1-Channel Codec
Integrated Graphics	No
Other Features	Qflash, @BIOS, EasyTune4, separate daughter card, Norton Internet Security 2003
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	http://www.giga-byte.com
Price	$169.99

System Specs	
Component	**Model**
Motherboard	GIGABYTE GA-K8VNXP
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7200rpm 8MB cache
Optical Drive	Optorite DD0405 DVD±RW Writer (8X/4X/12X DVD+RW, 8X/4X/12X DVD-RW, 40X/24X/40X CD-RW)
Chassis	ANTEC Life Style Black Case/380W Power Supply, Model SONATA
Operating System	Windows XP Home

Overclocking

Based on our experience with overclocking GIGABYTE boards, we approached overclocking this mobo with caution. The last thing we wanted was a mobo-beque, so we left the CPU Voltage alone to avoid the awful smell of mesquite PCB. You're more than welcome to adjust the CPU Voltage at your own risk; we'll bring the KC Masterpiece.

We were able to overclock the Athlon 64 3700+ to 2.54GHz with the GA-K8VNXP—not too shabby. Our 3DMark03 score improved to 5908, but, not surprisingly, the overclocked GA-K8VNXP raised our PCMark04 scores the most. The mobo posted an overall score of 4755, a 175-point increase over our stock results. 4670, 3827, 4706, and 4525 were our individual results for CPU, Memory, Graphics and HDD test, respectively.

The overclock brought us closer to reaching the fluke results we saw in Halo with the 3200+. We scored 56.72fps at 800 x 600, 51.23 at 1,024 x 768, and 35.89 at 1,280 x 1,024. In Doom 3, our results were 28.5fps at 800 x 600, 19.9fps at 1,024 x 768, and 13.8 at 1,280 x 1,024.

The GA-K8VNXP overclocked our other two Athlon 64s well, too. As usual, the 3200+ was our darling; our overclocked results for it and the 3400+ are available in our chart online.

Final Thoughts

Based on our tests, the difference in performance between the VIA K8T800 and NVIDIA nForce3 250Gb is so negligible it's a push. Neither gives you an obvious edge with stock or overclocked settings, and the chipset with the higher benchmarks will depend on which way the wind is blowing as much as anything else.

We'll give a slight edge to the GA-K8VNXP over EPoX's 8KDA3+ primarily because the former has FireWire, and we also think GIGABYTE did a better job with the physical layout. The separate daughter card with an extra active fan is a plus, too. On the other hand, you'll want to take the 8KDA3+ if you like SATA hard drives (and we do). EPoX also included round IDE cables, a minor but important detail. You'll get a great Socket 754 mobo no matter which one you pick. CPU

Overall Rating: CPU CPU CPU CPU

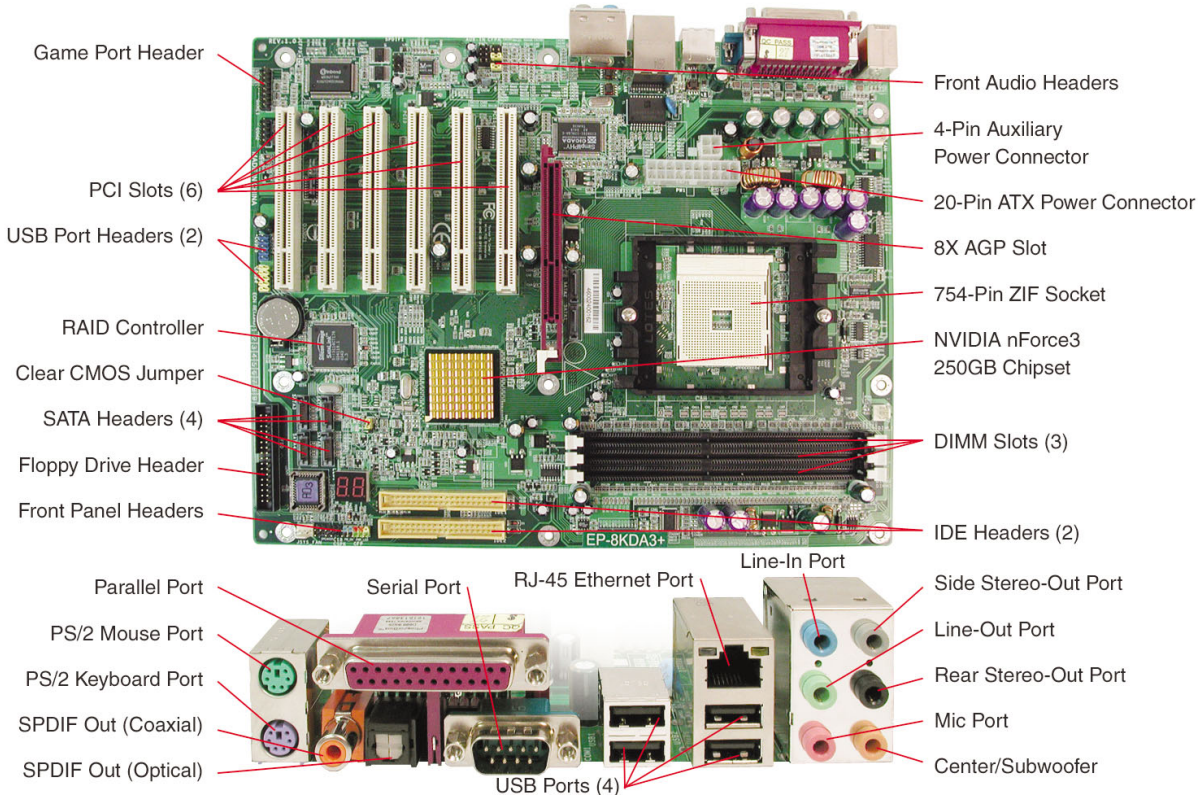
by Vince Cogley

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

EPoX 8KDA3+

LAYOUT: ATX (Socket 754)

CHIPSET: NVIDIA nForce3 250Gb



In many ways, the EPoX 8KDA3+ is like a confused teacher's pet. Although the company included a lot of extra "apples" with this mobo to score bonus gold stars, EPoX didn't do its homework on important items.

To its credit, we have plenty of good things to say about the 8KDA3+. It turned out to be a solid performer at default settings and a stable overclocker. Maybe we're just being picky, but we were a little surprised that EPoX composed a motherboard masterpiece and forgot to cross its T's.

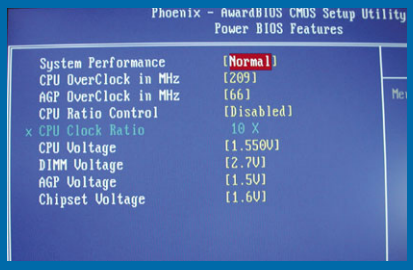
Motherboard

Although our 8KDA3+ mobo wields NVIDIA's nForce3 250Gb chipset, VIA fans will rejoice that the mobo is available with the VIA K8T800/8237 chipset instead (model 8HDA5+).

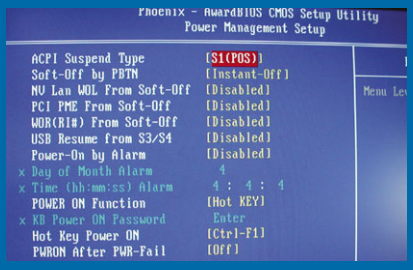
For piling as many features onto the 8KDA3+ as EPoX did, we expected a few design gaffes but were a little disappointed with the particular layout mistakes EPoX made. Besides lacking FireWire support, there's a disproportionate amount of confusion near the mobo's side ports. The CPU fan header was placed at some distance from the socket, and you'll need to orient the stock heatsink-and-fan combo so that the wire will reach the header.

Our biggest complaint is where EPoX chose to place the 20- and 4-pin ATX power connectors. They're lumped together just to the left of the CPU heatsink-and-fan combo mounting bracket, which virtually guarantees you'll have to drape the thick ATX power cable in front of the CPU fan, greatly inhibiting airflow. While the six SATA headers are worthy of a double-take, EPoX chose to plant two of them right above the AGP slot.

EPoX deserves compliments for a number of good decisions. The green PCB is a little ho-hum, but the grape-colored AGP slot and gold nForce3 250Gb chip heatsink add to the mobo's aesthetic appeal. Most of the pin-headers are situated on the outer edges of the board, and the IDE, SATA, and floppy headers are well spaced out. It's also very easy to access the CMOS jumper. There are three DIMM slots, and the 8KDA3+ accepts


Phoenix - AwardBIOS CMOS Setup Utility
Power BIOS Features
System Performance [Normal]
CPU OverClock in MHz [209]
AGP OverClock in MHz [66]
CPU Ratio Control [Disabled]
x CPU Clock Ratio 10 X
CPU Voltage [1.550V]
DIMM Voltage [2.7V]
AGP Voltage [1.5V]
Chipset Voltage [1.6V]

One of the most unique things we saw in the 8KDA3+'s BIOS was a separate setting to adjust the chipset voltage. As always, if you decide to fiddle with the voltage, be prepared to accept the rich, smoky aroma of a toasted motherboard.


Phoenix - AwardBIOS CMOS Setup Utility
Power Management Setup
ACPI Suspend Type [S1(POS)]
Soft-Off by PBTN [Instant-Off]
NV Lan WOL From Soft-Off [Disabled]
PCI PME From Soft-Off [Disabled]
WOR(RI#) From Soft-Off [Disabled]
USB Resume from S3/S4 [Disabled]
Power-On by Alarm [Disabled]
x Day of Month Alarm 4
x Time (hh:mm:ss) Alarm 4 : 4 : 4
POWER ON Function [Hot KEY]
x KB Power ON Password Enter
Hot Key Power ON [Ctrl-F1]
PWRON After PWR-Fail [Off]

up to 3GB DDR 400 RAM. Overall, the 8KDA3+ makes good use of space.

In addition to the standard PS/2, parallel, and USB (four rear 2.0 ports) ports, the 8KDA3+ has a serial port, a gigabit Ethernet RJ45 jack, and eight audio (eight-channel audio) ports, including a coaxial and optical SPDIF output. EPoX also included a game, COM, and two additional USB 2.0 ports on rear-mounting brackets.

Despite showing off an acceptable layout and myriad ports, EPoX supplies plenty of cool extras. In addition to a screwdriver set, which has two different sizes of Phillips and flatheads, the 8KDA3+ has two SATA cables, so you can set up a RAID 0 or 1 array without scrounging for an extra SATA cable. A SATA power adapter will further please RAID aficionados. Two round IDE cables are sheathed in a grape cover that matches the AGP slot.

The nForce3 250Gb chip controls two SATA ports and has basic RAID options. You can configure a RAID 0, 1, or, though it's not particularly useful, JBOD array.

The real RAID power lies in the Silicon Image Sil3114 chip, which supports RAID 0, 1, and 10. After receiving a successful POST screen, we pressed F4 to enter Silicon Image's RAID Utility. RAID 0 and 1 require two identical hard drives, and you'll need four identical hard drives to set up a RAID 10.

Curiously, we also found a small bag of bite-sized heatsinks included with the 8KDA3+. We're pretty sure you can use the small heatsinks for various chips scattered around the board, such as the audio codec or Ethernet controller.

Finally, the 8KDA3+ also has a small onboard LED-display device that helps users determine the root of a problem during boot failures.

Performance Comparison

Benchmark	AMD Athlon 64 3200+	AMD Athlon 64 3400+	AMD Athlon 64 3700+	Overclocked AMD Athlon 64 3700+ (OC 2.52GHz, 1.55V)
3DMark03 Build 340	**5809**	**5871**	**5886**	**5923**
PCMark04 1.2.0	**3964**	**4541**	**4559**	**4773**
CPU	3774	4435	4465	4641
Memory	3652	3568	3654	3808
Graphics	4899	4951	4971	4998
HDD	4336	4307	4316	4334
Halo				
800 x 600	50.92	52.45	53.73	55.69
1,024 x 768	49.41	50.38	49.48	52.29
1,280 x 1,024	36.02	36.28	35.45	36.41
Doom 3				
800 x 600	27.2	27.3	27.4	28.5
1,024 x 768	20.1	20.2	20.1	20.3
1,280 x 1,024	13.8	13.8	13.8	13.7
FSB Range	200-400			
CPU Voltage	1.550-1.700			
DIMM Voltage	2.5-2.8			
AGP Voltage	1.5-1.8			
Chipset Voltage	1.6-1.75			

Software

Again, we shouldn't slight EPoX too much because it did give us a great software package. However, the driver CD, which also includes the extra software, has a small but clearly discernable picture of Norton Ghost 2003 on its label. Unfortunately, we found Symantec Personal Firewall 2003 in its place. Extra software is always a plus, but because the nForce3 250Gb chip has a built-in firewall, Symantec Personal Firewall 2003 is a little bit of overkill. Norton Ghost 2003 may be outdated, but it would have been another advantage for overclockers.

EPoX did include a copy of PC-cillin 2004, one of the most current antivirus software packages.

EPoX rounds out its software package with a few additional utilities. AMD Cool'n'Quiet helps balance your CPU temperature and fan noise, while the MAGIC FLASH utility is yet another version of Windows-based BIOS-flashing software. You can also easily create RAID floppy disks for both the Sil3114 and nForce3 250Gb chips.

BIOS

Versatile voltage control is this mobo's forte. In addition to being able to adjust the CPU, RAM, and AGP voltage, you can also tinker with the chipset voltage.

You can't set the multiplier any higher than the number required to run a particular CPU at its default clock setting with a 200MHz FSB. You can set the FSB as high as 400MHz, which is more than a little excessive.

The rest of the BIOS options are standard on almost every other mobo, but the 8KDA3+ will also display several PC Health stats during boot-up.

Stock Performance

We rolled out AMD's finest 754-pin Athlon 64s to evaluate the 8KDA3+. We started with the 2GHz Athlon 64 3200+, moved up to the 2.4GHz Athlon 64 3400+, and finished our testing with the 2.4GHz

Athlon 64 3700+. Most of our scores were exactly on par with the rest of our other mobos, but we did achieve good overclocking results, especially with the 3200+.

On default settings, the 8KDA3+ paired with the Athlon 64 3200+ to score 5809 in 3DMark03. In PCMark04, the 8KDA3+ scored 3964. In individual tests, the mobo posted scores of 3774, 3652, 4899, and 4336 in the CPU, Memory, Graphics, and HDD tests, respectively.

When we ran the 8KDA3+ through our Halo benchmark, our results were also about the same as the rest of our gang of Socket 754 mobos. At 800 x 600, 1,024 x 768, and 1,280 x 1,024, the 8KDA3+ achieved 50.92fps, 49.41fps, and 36.02fps, respectively.

There weren't any surprises in store for us when we tested the 8KDA3+ on Doom 3, either. At 800 x 600, the board scored 27.2fps. Our fps dropped to 20.1 at 1,024 x 768 and 13.8 at 1,280 x 1,024.

When we swapped CPUs for the quicker 3400+, our 3DMark03 score climbed a little to 5871, but our PCMark04 score jumped to 4541. Our CPU score received the biggest boost, increasing from 3774 to 4435, a little less than 700 points. The Graphics score improved slightly to 4951, but our Memory and HDD scores dropped off to 3568 and 4307, respectively.

Based on our 3DMark03 scores, we weren't expecting shocking results in either Halo or Doom 3 benchmarks with the 3400+. The 8KDA3+ scored 52.45fps, 50.38fps, and 36.28fps in Halo and 27.3fps, 20.2fps, and 13.8fps in Doom 3 (800 x 600, 1,024 x 768, and 1,280 x 1,024).

Although our benchmark scores improved when we tested the 8KDA3+ with the Athlon 64 3700+, don't immediately discount this mobo because it scored slightly lower than some of its counterparts with older chipsets. We were well within the margin of error on all of our scores, and a BIOS or driver update can improve mobo performance, too. In 3DMark03, we received a score of 5886. Our PCMark04 Overall score improved a few digits to 4559. The 8KDA3+ scored 4465 in the CPU test, 3654 in the Memory test, 4971 in the Graphics test, and 4313 in the HDD test.

In our Halo and Doom 3 benchmarks, our fps was higher in some instances and lower in others. At 800 x 600, our fps was 53.73 in Halo and 27.4 in Doom 3. At 1,024 x 768, our fps was 49.48 and 35.45. Finally, the 8KDA3+ achieved 35.45fps in Halo and 13.8fps in Doom 3 at 1,280 x 1,024.

System Specs

Component	Model
Motherboard	EPoX EP-8KDA3+ (nForce 3 250Gb Chipset)
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX Power Pack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Optorite DD0405 DVD±RW Writer (8X/4X/12X DVD+RW; 8X/4X/12X DVD-RW; 40X/24X/40X CD-RW)
Chassis	ANTEC Life Style Black Case, 380W Power Supply, Model SONATA
Operating System	Windows XP Home

EP-8KDA3+ nForce3 250Gb Chipset

Socket Type	754
Chipset	NVIDIA nForce3 250Gb
Processor Support	Athlon 64 and Sempron processors
RAM Support	DDR up to 266/333/400, 3GB
RAM Slots	3
Graphics Bus	AGP 8X/4X
PCI Slots	6
SATA Ports	2 by nForce3 250Gb with RAID 0/1/JBOD, 4 by Sil3114 with RAID 0/1/10
IDE	2x ATA 133 up to 4 Devices
USB Ports	8 (USB 2.0, 4 rear)
FireWire Ports	0
LAN	Built-in nForce3 250Gb 10/100/1000Mbps Fast Ethernet
Integrated Audio	Realtek ALC850 selectable 2 or 8-CH audio CODEC with SPDIF
Integrated Graphics	No
Other Features	Screwdriver, small heat-sinks for various chips
Manufacturer	EPoX
Phone	(714) 680-0898
URL	www.epox.com
Price	$149

Overclocking

Although we're including our results from the overclocked Athlon 64 3700+, it's worth noting that the 8KDA3+ helped wring an additional 16.5% of stable clock speed out of the 3200+. Benchmarks for the overclocked 3200+ and 3400+ are available in our online chart.

Increasing the CPU voltage, which generally stabilizes a CPU and lets you raise its clock speed, didn't have any impact on our overclocking overtures. Our FSB wouldn't budge once we hit its ceiling, even after we increased the CPU voltage. We topped out at 210MHz for our FSB, giving us a clock speed of 2.52GHz. Although our 3DMark03 score didn't improve correspondingly (5923), our PCMark04 score (4773) was about the same percentage increase as the CPU's clock speed.

All of our individual PCMark04 scores improved, too. The 8KDA3+ scored 4641, 3808, 4998, and 4334 in the CPU, Memory, Graphics, and HDD tests, respectively.

The overclocked 3700+ bested its overclocked brethren in Halo and Doom 3, but the performance difference was so small that you wouldn't experience any change in gameplay. In Halo, the 8KDA3+ pumped out 55.69fps at 800 x 600, 52.29fps at 1,024 x 768, and 36.41fps at 1,280 x 1,024. In Doom 3, our scores were 28.5fps, 20.3fps, and 13.7fps at increasing resolutions.

Final Thoughts

The 8KDA3+ isn't perfect, but it's close. The absence of FireWire on such a new mobo is still puzzling, and the placement of a few particular items on the motherboard will force you to be creative if you want to achieve optimal airflow inside your case.

Otherwise, we don't see any reason why the 8KDA3+ can't be considered among the best Socket 754 boards. CPU

Overall Rating: 4 CPUs

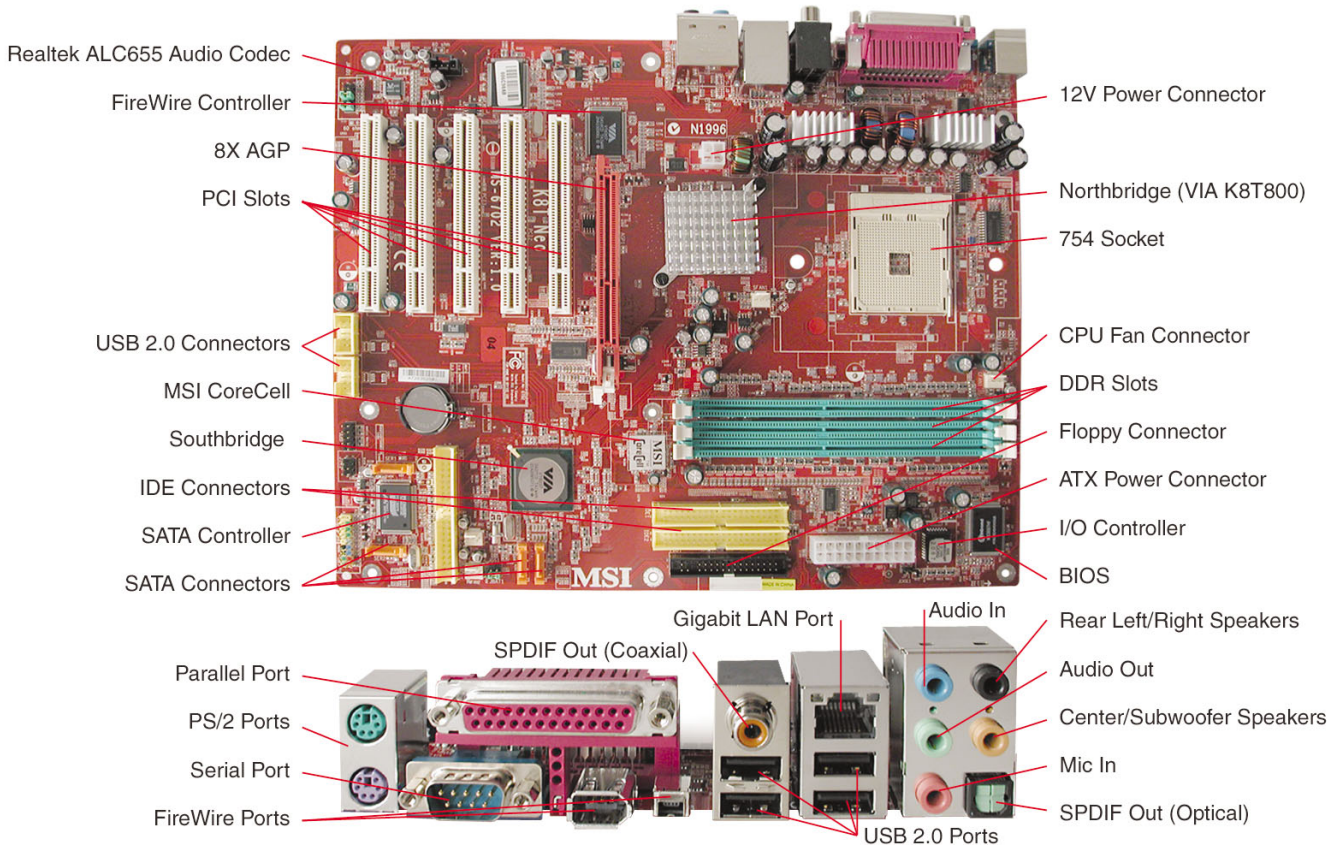
by Vince Cogley

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

MSI K8T Neo-FIS2R

Layout: ATX (Socket 754)

Chipset: VIA K8T800, VIA VT8237



MSI offers two flavors of its VIA K8T800-based, socket 754 motherboards. The $85 K8T Neo-FSR is less expensive than its full-featured sibling, but it has plenty of important features, including 6-channel audio, two SATA connectors (which support RAID 0 and RAID 1), and Gigabit LAN. Although we haven't reviewed this board, we like the feature set—if you're in the market for a sub-$90 board you may want to check out the K8T Neo-FSR.

With more features, the $107 K8T Neo-FIS2R picks up where the other left off.

Motherboard Layout

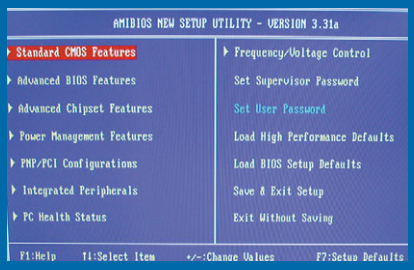
The K8T800 provides an 800MHz DDR FSB and supports the popular 8X AGP graphics card slot. Oddly enough, MSI skipped a fan and instead dropped a large, aluminum heatsink onto the chip. Overclockers may want to replace the heatsink with a heatsink/fan combo; we noticed a system fan header nearby. Also, the board has two holes near the northbridge; many heatsinks can attach to your motherboard via these holes (in fact, the board's heatsink uses them). We're glad to see that MSI didn't try to innovate here: Some manufacturers don't create the holes and use unconventional heatsinks. Obviously, you'll have a harder time replacing one of those heatsinks than you will with MSI's plain-old heatsink.

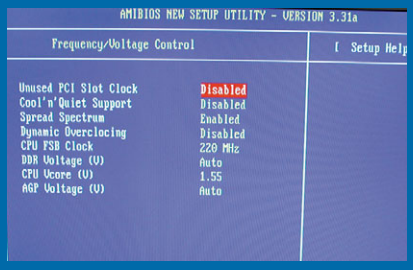
The other half of the chipset is the VT8237, which handles the IDE ports and two of the board's four SATA connectors (it also handles RAID 0, 1 for those connectors). The VT8237 also supports up to eight USB 2.0 ports, and we're happy to report that the board provides all eight via four external and two internal connectors (each of the internal connectors supports two USB ports). Thanks to this layout, you have plenty of backend USB ports and you can attach your chassis' front panel USB ports to the internal connectors.

The board's other chips include a Realtek ALC655 (AC'97 2.3) audio codec, which provides the 6-channel sound and SPDIF ports and supports goodies such as EAX, and a VIA VT6307 FireWire controller. We're glad to see FireWire support, but

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

(Left) Recognize the PC Health Status label? Most, if not all, modern BIOSes have PC Health (or similarly named) sections that display vital information, such as CPU temp and fan speeds. (Right) Use the Frequency/Voltage Control menu in the BIOS to boost your FSB or enable the Cool'n'Quiet automatic fan control feature.





MSI K8T Neo-FIS2R	
Socket Type	Socket 754 AMD
Chipset	VIA K8T800, VT8237
Processor Support	Athlon 64
RAM Support	2GB DDR400/333/266
RAM Slots	3
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (RAID 0, 1, 0+1)
IDE	3 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	2 external
LAN	Realtek RTL8110S-32 Gigabit
Integrated Audio	6-channel, SPDIF
Integrated Graphics	N/A
Other Features	"Cool'n'QuietCoreCenter DOTLive Monitor"
Manufacturer	MSI
Phone	(626) 913-0828
URL	www.msicomputer.com
Price	$107

we're disappointed to see that MSI chose two external ports instead of the more common one-external, one-internal setup. As a result, you can't plug your chassis' front panel FireWire port into your motherboard. However, we've seen 5.25-inch devices (often temperature control or monitoring devices) that have FireWire ports. Some devices have cables that plug directly into the motherboard, but other devices simply run the cable through your system to one of the chassis' PCI bays. The cable exits the PCI bay and attaches to one of your back-panel FireWire ports. This sort of device won't help your case's lifeless FireWire port, but it gets connectivity to the front, and that's what counts.

A Promise PDC20378 handles the other two SATA connectors, which stand directly below the third IDE connectors. Thanks to the extra connectors, you have a variety of RAID options, including RAID 0 and RAID 1. All four SATA connectors and the third IDE connector are near the bottom-right corner of the board.

Layout. Socket 754 boards don't support dual-channel technology, so we weren't surprised to see that the K8T Neo-FIS2R has only three slots. Capacitors surround the slots but don't stand near the tabs, so we didn't have any trouble adding and removing DIMMs. Capacitors crowd one side of the CPU socket retention frame, but they won't block the heatsink clips.

If you have several fans that use the small, 3-prong connectors instead of standard ATX power connectors, you'll like the K8T Neo-FIS2R's extra fan connectors. In addition to the header near the northbridge, two fan connectors stand near the board's SATA ports.

Not surprisingly, MSI placed the 20-pin ATX power connector on the right side of the board, just above the IDE and floppy connectors. The fat, stiff power cable is your PSU's most unwieldy cord, so we're glad to see that MSI doesn't make you snake it around any components. Unfortunately, MSI stuck the 12V connector near the northbridge, so you'll have to drag that cable over or around the memory and the northbridge. That said, the 12V cable won't cross the CPU fan.

MSI packed the I/O area: The riser includes several standard audio ports, an optical SPDIF port, and a coaxial port. It also houses the USB and FireWire ports (a standard port and a mini port) and the Gigabit port, which has two activity LEDs.

Extras. MSI won't pummel you with expansion modules, but it generally provides quality extras packages. The K8T Neo-FIS2R includes two bright orange SATA cables with dust caps, a SATA power connector adaptor that supports two hard drives, a rounded IDE cable, and a rounded floppy cable. MSI simply wrapped mesh around the ribbon floppy cable, but the IDE cable has a thick rubber shell and pull-tabs.

The package's single expansion module has two USB 2.0 ports and four LEDs that flash during POST. Although we prefer audible POST and troubleshooting messages, we also like MSI's Diagnostic LED system. If your system has trouble booting, you can match the LED pattern to the mobo manual's list of codes. Each code includes a brief description. The module isn't the ultimate troubleshooting tool, but when your PC refuses to load the OS, it's better than nothing.

MSI also scores points for tossing not one, but two driver floppies into the mix. If you use SATA hard drives, you'll need to install the SATA drivers during the Windows installation. You can pull the drivers onto any floppy from the board's driver CD, of course, but users who don't have a functioning PC handy will appreciate the ready-to-go drivers.

Software

Try MSI's CoreCenter utility when you overclock your system. The Windows-based CoreCenter interface is sort of cheesy (then again, we haven't seen a mobo OC utility that didn't have a cheesy interface), but the utility has plenty of useful information, including temps, fan speeds, and voltages. The utility's right-hand collapsible interface lets you use the program's slider bars to set alarms that will alert you when the CPU exceeds a certain temp (keep in mind that the board gauges CPU temp by load, not by using a thermometer) while

Performance Comparison				
Benchmark	AMD Athlon 64 3200+	AMD Athlon 64 3400+	AMD Athlon 64 3700+	AMD Athlon 64 3700+ 2.4GHz at 2.54GHz, 1.55V
3DMark03 Build 340	5195	5242	5263	5291
PCMark04 1.2.0	3949	4479	4536	4740
CPU	3746	4403	4438	4643
Memory	3659	3574	3645	3820
Graphics	4300	4320	4329	4401
HDD	4479	4486	4471	4511
Halo				
800 x 600	47.6fps	49.79fps	50.76fps	52.52fps
1,024 x 768	44.35fps	45.29fps	46.34fps	47.08fps
1,280 x 1,024	31.44fps	31.47fps	31.89fps	31.99fps
Doom 3				
800 x 600	24.2fps	25fps	24.9fps	25.1fps
1,024 x 768	17.7fps	17.8fps	17.8fps	17.9fps
1,280 x 1,024	12.1fps	12fps	12.2fps	12fps

the left interface lets you adjust the FSB and several voltages.

Once you adjust the FSB and voltage settings, you can save this overclock profile and then leave your system at stock settings when you aren't playing games or running CPU-intensive tasks. When you're ready to stress your system, simply reinstate the saved settings.

CoreCenter also controls Cool'n' Quiet. If you enable Cool'n'Quiet mode, the feature monitors your CPU's temp (again based on load rather than actual temp) and then adjusts the fan speed to keep the CPU cool.

BIOS

If you fear the smell of a burning PC but still want to squeeze a few more fps from your favorite games, you'll like the American Megatrends BIOS' Load High Performance Defaults feature that graces the main menu. Unlike Load BIOS Setup Defaults, which resets your system to its safe, factory settings, the High Performance feature automatically overclocks the system. A BIOS message warns users that the feature may destabilize the system—the BIOS isn't kidding. When we enabled the Load High Performance Defaults feature, our test system couldn't load Windows.

Hardcore overclockers will head straight for the Frequency/Voltage Control section, but newbies who want more than the High Performance feature should also check this section out. This menu has the most important OC features, including the AGP, CPU, and DDR voltage fields and the CPU FSB Clock field. You can also enable AMD's Cool'n'Quiet feature from here. If you're new to overclocking, enable the Dynamic Overclocking field. As with the main menu's High Performance feature, this section automatically overclocks your system, but it lets you choose the overclocking "Level." For example, you can start small by choosing the Private level and then work your way through Sergeant, Captain, Colonel, and General. Keep in mind that these settings might still fry your system, and make sure you disable this feature before you manually overclock.

System Specs	
Component	**Model**
Motherboard	MSI K8T Neo-FIS2R
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual-Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

Stock Performance

MSI boards regularly post solid scores at stock settings, and the K8T Neo-FIS2R is no exception. With the Athlon 64 3200+ at the helm, the board posted a 3DMark03 score of 5195 (10 points higher than the Soltek SL-K8AN2E-GR's score) and a not-quite-so-solid 3949 PCMark04 score, which lagged a little behind the Soltek board's PCMark04 score of 3974. In fact, we found that when we ran the Athlon 64 3400+ and the Athlon 64 3700+ on both boards, the K8T Neo-FIS2R took the 3DMark03 crown, but the SL-K8AN2E-GR took the PCMark04 crown. That said, both boards boasted solid scores in both benchmarks.

We hoped that a clear winner would emerge when we ran the game benchmarks, but they only confused matters more. Both boards posted near-identical frame rates in Doom 3, but the Soltek board consistently pulled a few frame rates ahead of the K8T Neo-FIS2R in the Halo demos. At stock settings, the boards are neck and neck.

Overclocking

The K8T Neo-FIS2R finally pulled ahead of the Soltek board when we overclocked the three processors. The board posted higher 3DMark03 scores across all of the CPUs and also pulled in higher scores when it ran PCMark04 with the 3200+ and the 3400+, and scored only slightly lower than the SL-K8AN2E-GR when it took on the FX-53. Again, both boards offered similar scores when we ran Doom 3, but the Soltek board took a strong frame rate lead when the system ran the Halo demo.

Final Word

First, the downsides: The K8T Neo-FIS2R doesn't have the latest Realtek 8-channel audio codec, but if you use an add-on sound card, you won't care about integrated audio. But the board has plenty to like, too: It has both IDE and SATA RAID options, plenty of audio ports, and support for eight USB 2.0 ports.

That said, the K8T Neo-FSI2R is a strong board at stock settings and an even stronger board at overclocked settings. If you're planning to overclock your system, you won't have any complaints about this motherboard. Keep in mind that we used the stock aluminum AMD heatsink—if you use a copper heatsink or more exotic cooling methods, you'll probably blow these scores out of the water. CPU

Overall Rating: CPU CPU CPU CPU

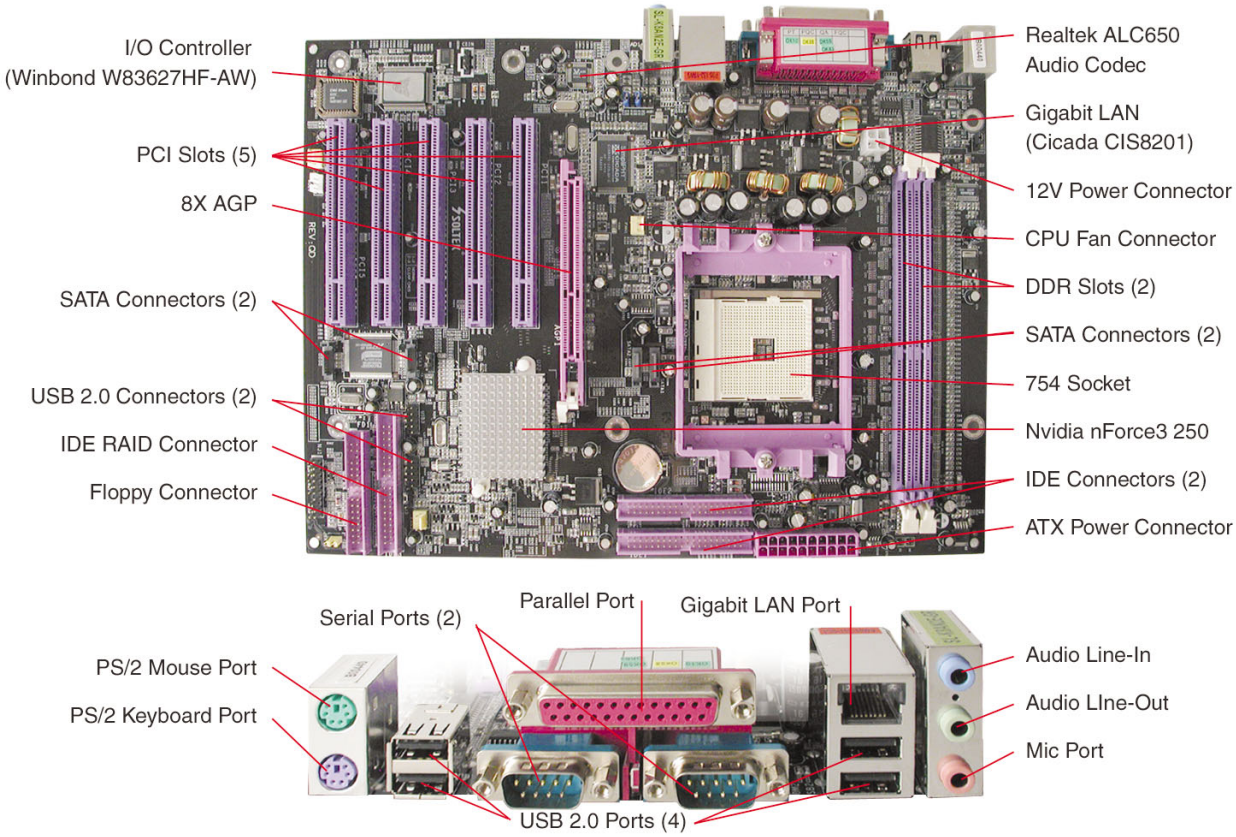
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

Soltek SL-K8AN2E-GR

Layout: ATX (Socket 754)

Chipset: NVIDIA nForce3 250



Some motherboard manufacturers use colors to help their customers identify important components such as internal USB connectors, the AGP slot, and different memory slot channels (on dual-channel boards). We like colored components for that same reason; although we're not likely to mix up AGP and PCI slots, PC-building newbies need all the help they can get when they try to match board components to their installation guide diagrams.

With the SL-K8AN2E-GR, Soltek created a particularly classy board by attaching purple components to a black PCB. Unfortunately, it looks like Soltek's artistic touch doesn't extend to its board names.

Motherboard

The SL-K8AN2E-GR boasts NVIDIA's nForce3 250, which combines the traditional northbridge/southbridge model into a single chip. We like this model because it saves precious PCB space, but we've found that many mobo makers place the nForce3 250 just behind the AGP card. The location prevents users from replacing the standard heatsink with a taller heatsink, so we were glad to see that Soltek placed the chip behind the top PCI slots, just to the side of the AGP slot. We also noticed that a fan connector stands near the northbridge heatsink, which means you can replace the standard heatsink with a heatsink/fan combo. The nForce3 250 controls two of the board's four SATA connectors and supports Gigabit LAN.

The other SATA controller is a Promise PDC20579, which also handles the nearby IDE connector. Unlike the two standard IDE connectors that are up by the CPU socket, this connector supports only one device. (The other IDE connectors support two each.) The PDC20579 and its connectors provide RAID capabilities, which

means that both the SATA ports and IDE ports support RAID 0 and RAID 1.

We weren't surprised to see the Cicada CIS8201 Gigabit LAN chip or the Winbond W83627HF-AW I/O controller, but we were disappointed to find that Soltek stuck with the bottom of Realtek's 6-channel audio codec barrel, the ALC650 (AC'97 2.2). It's not a bad chip (it supports SPDIF input and output) and most users either won't care about the chip's standing in the 600 series or will switch to a PCI add-on sound card, but we'd prefer the ALC655, which supports EAX and other features, or the ALC850, which has 8-channel sound. Unfortunately, Soltek skipped a FireWire controller. Thanks to the iPod and other FireWire devices, many manufacturers put a FireWire port on the front panel, near the front USB ports, so we hate to see boards that lack even one internal FireWire connector.

A row of capacitors stand about 2mm from the purple CPU socket retention frame, but Soltek left a little space between the third and fourth capacitor. As a result, we were able to push the heatsink's clip over the hook and later remove it.

The board has several jumpers, including Keyboard/Mouse Wakeup jumpers. (Once you enable the Wakeup feature, you can pull the system out of Suspend mode by tapping the keyboard or moving the mouse.) Soltek placed black jumper caps on most headers, but it placed a yellow cap on the CMOS header. We've seen some boards that have complicated CMOS clearing methods, but Soltek kept things simple: Power off the system, move the cap from the Pin 1, 2 position to the Pin 2, 3 position for a few seconds, and then move it back.

Oddly enough, Soltek added only two memory sockets to the motherboard. Socket 754 motherboards don't support dual-channel memory, so we didn't expect to see more than three slots, but most mobo makers stick to three. The existing slots still support a respectable 2GB of memory, but if you want to hit the max, you'll need to invest in two 1GB DIMMs instead of, say, a 1GB DIMM and two 512MB DIMMs. Why does this matter? It doesn't if you can afford the 2GB off the bat, but if you want to buy a 512MB DIMM now and another later, you're stuck with half the board's maximum memory.

Soltek placed the 12V connector on the left side of the board, but you can snake the cable to it without blocking anything important, as the retention frame and memory DIMMs create a lane from the right side of the board to the connector. Luckily, Soltek doesn't make you play this game twice: The ATX power connector is on the right side of the board.

Soltek SL-K8AN2E-GR	
Socket Type	Socket 754 AMD
Chipset	NVIDIA nForce3 250
Processor Support	Athlon 64
RAM Support	2GB DDR400/333
RAM Slots	2
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (RAID 0, 1, 0+1)
IDE	3 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	N/A
LAN	Cicada CIS8201
Integrated Audio	6-channel
Integrated Graphics	N/A
Other Features	"Soltek H/M MonitorSmartDoc"
Manufacturer	Soltek
Phone	N/A
URL	www.soltek.com.tw
Price	$99

Performance Comparison				
Benchmark	**AMD Athlon 64 3200+**	**AMD Athlon 64 3400+**	**AMD Athlon 64 3700+**	**AMD Athlon 64 3700+ 2.4GHz at 2.54GHz, 1.55V**
3DMark03 Build 340	5185	5229	5253	5285
PCMark04 1.2.0	3974	4497	4552	4787
CPU	3762	4412	4456	4684
Memory	3648	3563	3645	3851
Graphics	4489	4541	4545	4598
HDD	4286	4288	4297	4330
Halo				
800 x 600	51.03fps	52.88fps	53.26fps	54.31fps
1,024 x 768	45.67fps	46.1fps	46.57fps	47.55fps
1,280 x 1,024	31.53fps	31.57fps	31.69fps	32fps
Doom 3				
800 x 600	24.2fps	25.1fps	24.4fps	25fps
1,024 x 768	17.7fps	17.8fps	17.8fps	17.6fps
1,280 x 1,024	12.1fps	12fps	12.2fps	12.2fps

Extras

Not surprisingly, both the rounded IDE cable and ribbon floppy cable are purple. It's too bad Soltek stuck with the ribbon floppy cable, as the wide, flat cable disrupts your chassis' airflow.

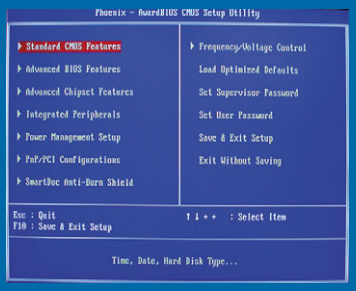
Soltek finally messed up its purple theme by tossing two bright red SATA data-transfer cables into the package, but we're not complaining. The package also includes a SATA power connector adapter that supports two hard drives and two SATA driver disks. You'll need the driver disks during the Windows Installation. Thanks to the driver disks, you'll have everything you need when the Windows installation barks that it can't find your hard drive.

Software

Mobo makers rarely toss more than one CD into the box, but Soltek devoted a second CD to several third-party utilities, including PC-cillin 2004, VirtualDrive 7, RestoreIT! 3 Lite, PartitionMagic 6.0 SE, and DriveImage 4.0. Soltek also included its new Hardware Monitor, a Windows-based utility that displays the CPU temp (based on CPU load, not actual temp), CPU and other voltages, and fan speeds—in short, everything that the BIOS monitor includes. The monitor doesn't have any overclocking capabilities, so new users will have to flip through the same BIOS screens as old pros. Even so, the monitor is worth installing, especially if you suspect that your system has heat or fan issues.

BIOS

The SL-K8AN2E-GR's Phoenix BIOS has the standard menus, including Advanced Chipset Features, Power



Can't find the PC Health section? The SmartDoc Anti-Burn Shield handles the board's system monitoring features.

Oddly enough, you won't find the BIOS' CPU Overclock In MHz field in the Frequency/Voltage Control section. Why make things easy to find when you can hide them in other parts of the BIOS?

Management Setup, and Integrated Peripherals. It also displays the SmartDoc Anti-Burn Shield category, which is the BIOS' PC health section. SmartDoc shows the same information Soltek's Hardware Monitor software displays, including fan speeds, temps, and voltages.

And like the Hardware Monitor, SmartDoc won't let you adjust any of the board's properties. To overclock your system, you'll need to enter the Frequency/Voltage Control section, which also appears on the main menu. This section has some common overclocking features, such as the CPU VCore and AGP voltage settings. You can only overclock your system by changing the multiplier; the FSB remains at 200MHz. We were also surprised to find that the CPU Vcore Select field has a range of 0.8 to 1.55V—most motherboards offer voltage ranges that top 1.7V.

It also has a CPU Ratio field that lets you choose from a multiplier range of x4 to x20. Unfortunately, the section doesn't have the most common field of all: the frequency field. You can change the FSB, but you'll need to back out of the Frequency/Voltage Control section and then enter the Advanced Chipset Features section.

Although the FSB's odd location shouldn't dissuade most potential overclockers from buying this board, the crippled VCore voltage range should.

System Specs

Component	Model
Motherboard	Soltek SL-K8AN2E-GR
Processor	AMD Athlon 64 3200+
Processor	AMD Athlon 64 3400+
Processor	AMD Athlon 64 3700+
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

Stock Performance

Soltek's SL-K8AN2E-GR posted strong 3DMark03 scores out of the gate, but it couldn't quite catch up to some boards, such as the MSI K8T Neo-FIS2R, which consistently scored as many as 13 points higher when we tested our three processors. However, the Soltek board took the lead as soon as we fired up PCMark04, which assesses the system's office task performance; the SL-K8AN2E-GR outscored the MSI board with every processor.

Next, we ran Halo and Doom 3's demos. Again, both boards produced strong frame rates, but the SL-K8AN2E-GR clearly took the lead when it ran Halo. The Soltek board bettered the K8T Neo-FIS2R with every processor, if only by a few fps. However, both boards produced almost identical frame rates when we ran Doom 3. Whether you're a Doom 3 fan or a Halo fan, you won't be disappointed with either board's performance.

Overclocking

The SL-K8AN2E-GR doesn't include Windows-based overclocking software, but we're not complaining: We didn't have any trouble overclocking it the old-fashioned way. The board responded well to higher frequencies and produced solid scores right away, but it didn't really take off until we pushed the CPU voltage to its highest setting, which was 1.55V. As we mentioned earlier, we're disappointed that the board doesn't let users choose higher voltages than the meager 1.55V; we think that we probably could have pushed the system further if it had more juice.

The Athlon 64 3700+ finally maxed out at 2.54GHz (212MHz frequency) with a 1.55V VCore. At that speed, the system produced a 3DMark03 score of 5285, only 32 points higher than its score at stock settings. Even so, the score didn't land too far behind the K8T Neo-FIS2R's 3DMark03 score of 5291. The Soltek/3700+ combo beat the MSI board's PCMark04 score by several points, but the board posted lower scores when we popped the other two processors into the system.

Final Word

Although the FSB's odd location shouldn't dissuade most potential overclockers from buying this board, the crippled VCore voltage range might. Many CPUs have 1.5V default voltages, which means you can up the voltage twice (0.25V steppings) before smacking your head against the board's unreasonably low voltage ceiling. That's too bad: 1.6 to 1.7V often stabilizes the system and rarely fries the motherboard. That said, the board performed well at 1.55V. Overall, we like the SL-K8AN2E-GR. It's certainly flashy, it performs well, it has a solid extras package, and at $99, it's a bargain. CPU

Overall Rating: CPU CPU CPU CPU

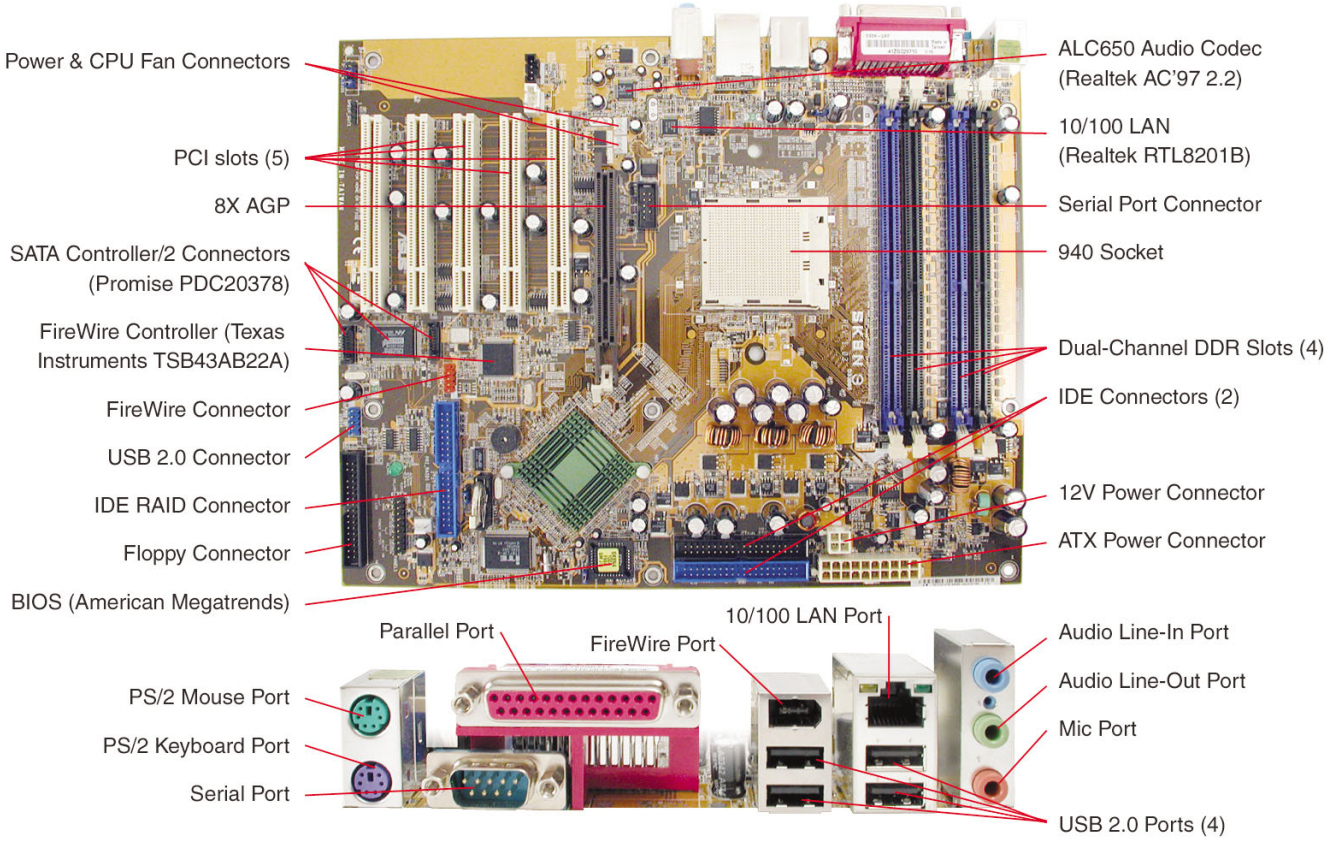
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless CPU CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

ASUS SK8N

Layout: ATX (Socket 940)

Chipset: NVIDIA nForce3 Pro-150



We've seen the SK8N more than once since AMD broke free of its death grip on the Athlon XP series. Although the SK8N was one of the first boards on the FX scene, it's a solid board that still challenges newcomers in 940-pin roundups. It lacks a nifty new ASUS overclocking feature that automatically resets the BIOS after system crashes, but its BIOS has several other ASUS tweaks, and the board has most of the features you'd expect to see on a $172 board, including FireWire 400 and dual-channel memory slots.

Speaking of memory, notice that we couldn't stick to the OCZ Dual Channel Series Gold Edition PC4400 memory that graces our test systems in the other motherboard reviews. The FX series has its roots in the 940-pin Opteron, which requires registered memory. As a result, FX processors also require the more expensive registered memory. We chose 1GB (in the form of two 512MB DIMMS) of OCZ's PC3200 Registered Dual Channel DDR memory. We're not surprised that the memory performs well; OCZ specifically designed this kit for the FX series. As with most registered memory, the DIMMs include ECC, but we disabled this feature.

Chip Talk

The NVIDIA nForce3 Pro-150 is really a chip rather than a chipset; a single, large, 0.15-micron-based chip handles both northbridge and southbridge duties. The chip dissipates heat efficiently, which means that you won't see the large heatsinks and fans that traditionally sit atop motherboard northbridges. Instead of a power-sucking fan, ASUS cools the chip with a slim, fanless, aluminum heatsink.

The nForce3 supports Gigabit LAN controllers and has NVIDIA Firewall, but ASUS opted for a 10/100Mbps Realtek RTL8201B PHY. We like to see Gigabit controllers on high-end boards, but this is a minor gripe. The chipset also supports AGP 8X, USB 2.0, and, of course, 64-bit processors.

A Realtek ALC650 (AC'97 2.2) chip provides the board's sound. The chip supports six-channel stereo sound, SPDIF, and two mic ports. Newer boards that house Realtek AC'97 chips will probably use the ALC655 (AC'97 2.3) or the 20-bit ALC658 (AC'97 2.3), which also support

six-channel audio and are compatible with EAX and Direct Sound 3D.

Layout

Thanks to the single NVIDIA nForce3 chip, the board has plenty of room. The chip sits where you'd expect to find the southbridge, just behind the AGP slot. Unfortunately, most AGP cards will hang over the chip, which means that although the board has two holes that support chipset heatsinks, you probably won't be able to replace the current heatsink. And a fan? Forget it.

ASUS took advantage of the empty northbridge area by adding a bunch of capacitors that crowd the CPU socket's retention frame. We didn't have any trouble sliding the heatsink clip between the capacitors and the retention frame hook, but we had to face the end of the heatsink that has the locking mechanism toward the I/O ports.

We were a little disappointed to see that ASUS put the CPU fan port right next to the power fan port. Experienced users won't have any trouble finding the appropriate port, but we can see newbies accidentally plugging the all-important heatsink fan cable into the wrong port. Speaking of fan port problems, both ports stand very close to the graphics card. Make sure you install the CPU and heatsink before you install the card.

We have only minor complaints about this board: It has only one internal USB 2.0 port, but it has four external USB ports, an external FireWire port, and an internal FireWire port. The floppy port sits at the bottom of the board, which means you'll need to drag it over all of the ports above it to reach the floppy drive, but you can easily avoid this by using a rounded floppy cable.

We were surprised to see that the CMOS jumper sits between the battery and the IDE RAID port (the board has three IDE ports), but you won't have much trouble reaching it once you remove the battery, which you'll need to do when you clear CMOS anyway.

ASUS SK8N	
Socket Type	Socket 940 AMD
Chipset	NVIDIA nForce3 pro 150
Processor Support	Athlon 64 FX-53, Opteron 100 and 200
RAM Support	8GB Registered DDR333/266
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2 (RAID 0, 1, 0+1)
IDE	2 ATA 133
USB Ports	6; 4 external, 1 internal that supports 2 (2.0)
FireWire Ports	1 external, 1 internal
LAN	RealTek RTL820 10/100
Integrated Audio	6-channel, SPDIF
Integrated Graphics	N/A
Other Features	CrashFree BIOS2 MyLogo2 Q-Fan EZ Flash
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com
Price	$172

Performance Comparison		
Benchmark	**AMD Athlon 64 FX-51**	**AMD Athlon FX-53**
3DMark03 Build 340	5166	5190
PCMark04 1.2.0	4222	4515
CPU	4165	4519
Memory	5371	5525
Graphics	4042	4063
HDD	3875	3911
Halo		
800 x 600	50.67fps	50.47fps
1,024 x 768	39.62fps	39.68fps
1,280 x 1,024	26.57fps	26.75fps
Doom 3		
800 x 600	23.7fps	23.1fps
1,024 x 768	17.2fps	17.2fps
1,280 x 1,024	11.7fps	11.9fps

Extras

The SK8N's package includes a two-port USB 2.0 expansion module that connects via a single internal USB header. However, most users will probably want to attach their case's front-panel USB ports to this connector, so we doubt many users will bother with the bracket. We like the rest of the extras package, which includes a FireWire bracket (as with the USB header, the internal FireWire header will probably power a front-panel port instead), and a serial-port bracket that complements the I/O area's single serial port. ASUS could have simply placed the second serial port next to the first, but it used the bracket so users can take advantage of the internal header.

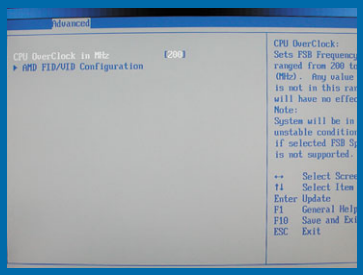
BIOS

As with many other mobo manufacturers, ASUS tweaks the BIOS to fit the motherboard. The release version (American Megatrends ASUS 1001) let users tweak a few basic settings, such as the frontside bus, but it didn't have a multiplier adjustment option. Although we find that tweaking the FSB alone yields the best results, AMD fans like to lord the multiplier's tweakability over the Intel crowd, so we were surprised to see that ASUS didn't add multiplier-adjustment support to the board that matched AMD's top enthusiast processor. In fact, ASUS didn't add the feature to version 1002, which had a couple of minor bug fixes and several code tweaks, but the mobo builder didn't hold out on its fans for long; version 1003 brought an adjustable multiplier feature that ranges from x4 to x20 in x1 increments.

We flashed the latest BIOS version (1007) to the board so we could take advantage of the multiplier OC feature and another tweak (which originally accompanied version 1004) that breaks the range from x1 increments to x.5 increments. That's a plus: x.5 bumps the FSB by 100MHz instead of x1's 200MHz. Version 1007 also has a fix that helps the board play nice with newer 940-pin processors.

Not surprisingly, the Advanced tab is the key to all the exciting features. The CPU Configuration menu has only two

American Megatrends uses a simple tabbed format that lets users quickly browse feature categories. Note the box at the right of the screen, which explains each highlighted setting. We can't call it detailed, but it's not bad.



It may not look like much, but the CPU Configuration menu has some great overclocking tools. You can adjust the multiplier, Vcore voltage, and clock speed without leaving the menu.

fields: CPU OverClock in MHz and AMD FID/VID Configuration. The first offers a generous FSB range of 200 to 300MHz, and the second lets you tweak the multiplier and Vcore voltage, which has a large range (1.775 to 1.4V). You'll need to switch the FID/VID Change field from Auto to Manual to view the multiplier and voltage options.

The Chipset menu, another denizen of the Advanced tab, includes the North-Bridge Chipset Configuration page, which handles everything memory. The page displays the RAM's clock speed and timings, such as CAS, TRCD, TRAS, and TRP. The page also displays the memory's voltage (2.5V, 2.6V, and 2.7V). You can't change the timings or enable ECC from this page, but the Memory and ECC Configuration submenus let you tweak to your heart's content. Although our memory supports ECC, a feature that harkens back to the board's (and processor's) server root

System Specs

Component	Model
Motherboard	ASUS SK8N
Processor	AMD Athlon 64 FX-51
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL DDDR ECC Reg PC3200 2-3-2-6 OCZ4001024-ELERDC-K
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

and reduces errors; we didn't enable it though, as the feature slows your desktop.

We almost missed the Hardware Monitor, which hides at the bottom of the Power tab. This section displays CPU and motherboard temps, fan speeds, and several voltages, including the Vcore voltage. It also houses the Smart Q-FAN Function. Overclockers probably won't use this feature, but if you plan to use the default settings, flip it on so that the motherboard can adjust the CPU's fan to match the temperature. When your system isn't crunching numbers, the fan slows, (hopefully) reducing your machine's overall noise.

All users will like the CrashFree BIOS 2 feature. You'll ignore CrashFree BIOS until that fateful day when your system refuses to boot and instead displays Bad BIOS Checksum. Simply pop the driver CD into your CD-ROM and watch your PC heal itself. If you want to back up this crucial feature, you can copy it to a floppy disk. When the mobo detects BIOS trouble, it checks both your floppy drive and CD-ROM for CrashFree BIOS.

Once you install Windows, you can install ASUS Update, a BIOS-update utility that lets you download and install the latest BIOS. The driver CD has an old version that can't handle the latest BIOS updates, so skip it and download version 5.28.01 (the latest version available as we go to print) from the Web site. Unlike the board's drivers, you won't find it in the SK8N section. Instead, click the Download tab at the top of the main page and then click Motherboard, Utility, and Tools.

If you have a lot of time on your hands and absolutely must customize anything and everything about your PC, you'll get a kick out of the ASUS MyLogo2 feature, which lets you swap the ASUS POST Logo with your own image. You'll need to install ASUS Update and enable ASUS My Logo2 in the BIOS. Overall, we like the SK8N's BIOS: It offers simple menus and the description menu has reasonably coherent menu explanations.

Performance

We ran into trouble when we tried to overclock our Socket 940 boards, despite using the latest BIOSes and swapping out component after component. GIGABYTE blamed the problems on a conflict with the Athlon 64's internal memory controller and told us that it is releasing BIOS patches for several boards (including, eventually, its Socket 940 board, the GA-K8NNXP-940). The other manufacturers weren't aware of any overclocking problems. That said, the boards performed well at stock settings.

The SK8N's scores won't turn heads, but it's no slouch: The board posted 5166 and 5190 in 3DMark03 (with the Athlon 64 FX-51 and FX-53, respectively). The board also didn't post shocking scores when we ran PCMark04, but it posted strong frame rates in both Halo and Doom 3.

Final Word

Overall, the SK8N is a decent Socket 940 motherboard. It has a strong extras package, internal and external FireWire ports, and plenty of overclocking settings. It's not a performance champ, but it produces solid scores. That said, we'd take its sibling, the SK8V, over the SK8N any day of the week. The SK8V offers better performance and has more features. CPU

Overall Rating: 4.5

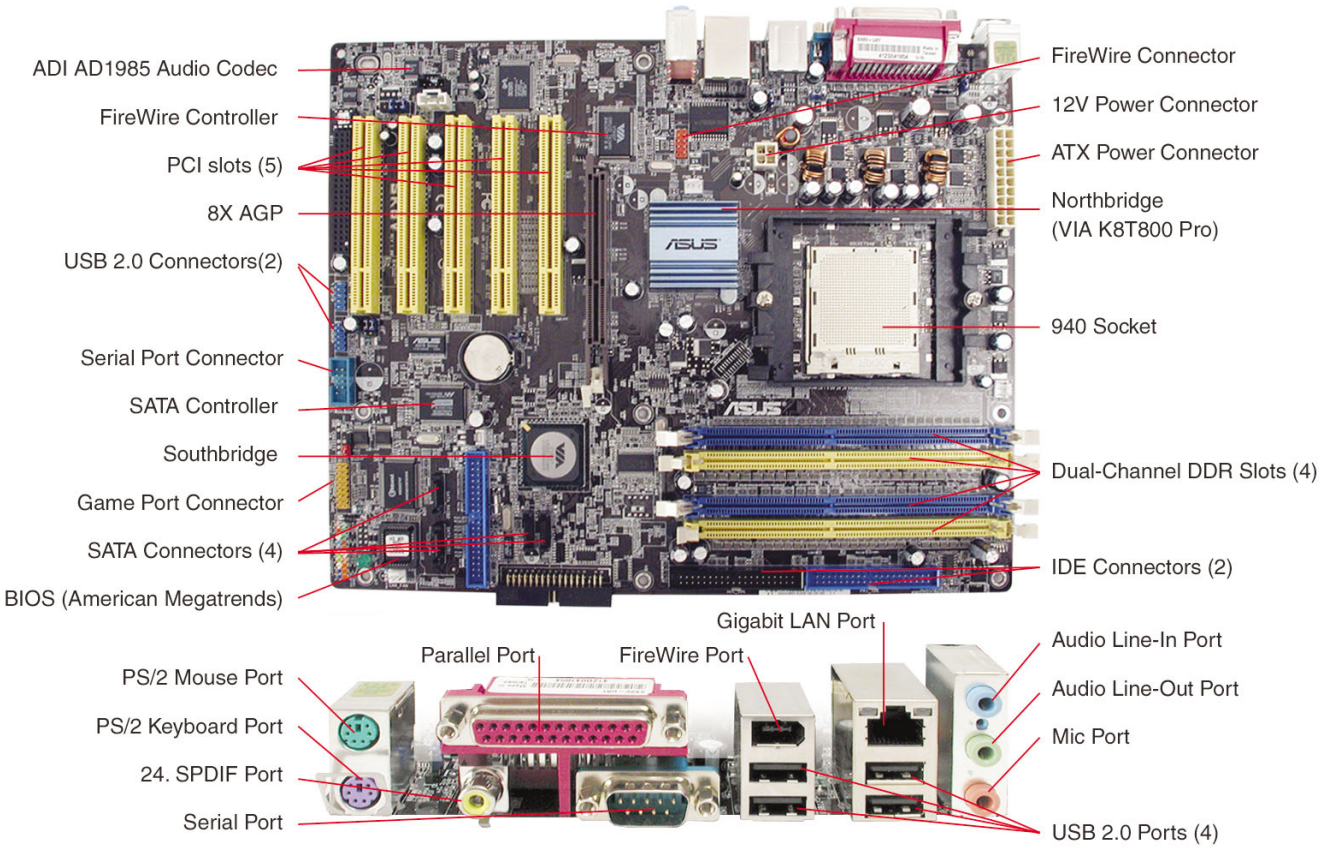
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

ASUS SK8V

Layout: ATX (Socket 940)

Chipset: VIA K8T800 Pro, VIA VT8237



ASUS has been around since 1989, and the giant mobo maker didn't last this long by chance. ASUS regularly puts out some of the first boards to support new processors, and its AMD selections always include both VIA-based and NVIDIA-based boards, which means it has something for just about everyone. But ASUS offers more than a steady stream of new motherboards: It develops BIOS tweaks that range from odd, hard-to-justify "features," such as MyLogo2, to overclocking tools and safety features that can yank your system out of potentially fatal (to the mobo, at least) situations.

Chip Talk

The SK8V is a perfect example of ASUS' early-on-the-scene, feature-laden boards. The BIOS has plenty of tweaks, and the board itself boasts VIA's K8T800 Pro and VT8237 chipset. We like the K8T800 Pro because it supports Opteron and Athlon 64 processors, both 940-pin and 939-pin (keep in mind that we're talking about the chipset here, not the board). The K8T800 Pro supports Opteron processors, but it supports FX processors just as well, as the series has roots in the 64-bit server/workstation processors. In fact, you can pop an Opteron into the board without any trouble, but you'd be wasting cash on features you probably wouldn't use.

The VT8237 makes a great companion for the K8T800 Pro. It supports up to four SATA hard drives and four ATA hard drives in RAID 0 and RAID 1 configurations. The chip also supports up to eight USB 2.0 ports and up to six PCI slots. A 533MBps connection lets the two chips communicate quickly.

The southbridge supports Gigabit LAN, so ASUS added a 3Com Marvell 3C940 controller. We're glad to see Gigabit Ethernet; this is a feature that the SK8N doesn't support. The SK8V also includes a 400Mbps VIA VT6307 FireWire controller, a Winbond W83697HF I/O chip, and a Promise PDC20378 controller that handles the SATA connectors. An ADI AD1985 (AC'97 2.3) codec handles the board's integrated audio.

Layout

Aside from the location of the AGP and PCI slots and a few minor features, the SK8V's layout is entirely different

from its NVIDIA-based counterpart, the SK8N. The four dual-channel DDR slots stand vertically instead of horizontally, which isn't a problem; you can reach the slots just as easily as you can with the SK8N, and the DIMM clips don't butt up against any capacitors. You also won't have much trouble installing the CPU, as the socket-retention frame doesn't stand too close to capacitors. It does stand about 2mm from the aluminum northbridge heatsink, but we slipped our CPU heatsink's clip over the retention frame's hook without even touching the northbridge. The socket stands near the top of the board, next to the memory slots.

We have no complaints about the memory slots or the CPU socket: Our beef is with ATX and 12V power connectors. The ATX connector stands at the very top of the board, to the left of the CPU socket, while the 12V connector is several inches below its larger sibling. Because both of these connectors are on the left side of the board, you'll need to string two of your PSU's fattest cables across the board from the top-right corner. Not only that, but you'll have to run the ATX cable above the CPU and then run the 12V cable below the PSU. Our PSU has very tough cables, so we couldn't easily run the cable over the CPU. Instead, it ran right over the CPU's heatsink fan, potentially disrupting the airflow. If you have plenty of cable ties, you can keep the cords out of the way, but we prefer the standard power connector placement on the right side of the motherboard, which avoids this type of problem entirely.

Another odd layout problem is the floppy connector. Instead of pointing straight out, this one points toward the right. Unfortunately, the connector also hangs off the right edge of the board, which means that if you have a tight case, you may have trouble connecting your floppy cable.

Aside from those minor problems, we don't have any complaints about the layout or the features. The SK8V has two internal USB connectors, a FireWire connector, a game port connector, and a serial port connector. You can reach the CMOS jumper without any trouble (although you probably won't need to, thanks to a new BIOS feature). The board has three IDE connectors and four SATA connectors, which means you have plenty of RAID options.

We were surprised to find a small riser just below the bottom PCI slot—this is ASUS' WiFi riser, which supports the optional 802.11b WiFi@Home adapter (which runs about $25). The adapter includes an antenna and a cord, which means you can move the antenna around to get the best reception. The riser will also support 802.11g.

The I/O area isn't fancy, but it has a few notables, including the yellow SPDIF-out port, a row of audio ports, and a LAN port that has two activity LEDs. If you have networking problems, you'll like the LEDs; you can use them to determine if you have a connection when troubleshooting.

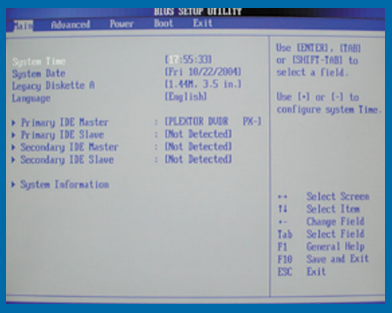
Extras

When it comes to packing the box with goodies, ASUS is one of the more generous manufacturers. The mobo maker tossed in two SATA cables, a SATA PSU adapter that lets you plug your power supply into up to two hard drives, a FireWire D-bracket, a four-port USB D-bracket, two black IDE cables, a floppy cable, and three spare jumpers (nice touch). We prefer round cables, as they don't clog your case and block the airflow, but these aren't bad, as ribbon cables go. We like the D-brackets, because users who don't have front-panel ports can take advantage of the internal connectors by routing them to the back of the PC via the brackets.

Unfortunately, ASUS doesn't put a SATA driver floppy into the package, which means that if you have SATA hard drives, you'll need to create your own driver floppy. The CD has utilities that copy the drivers to your floppy, but you'll need to use a functional computer to use the CD. That's no problem if you have a second computer, but if you're building your first and only computer, you'll need to

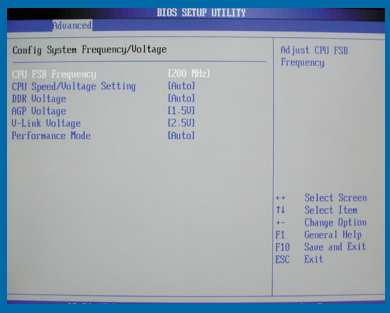
ASUS SK8V	
Socket Type	Socket 940 AMD
Chipset	VIA K8T800 Pro, VIA VT8237
Processor Support	Athlon 64 FX-53, Opteron 100 and 200
RAM Support	8GB Registered DDR400/333/266
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2 (RAID 0, 1, 0+1)
IDE	2 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	1 external, 1 internal
LAN	3COM 3C940 Gigabit
Integrated Audio	6-channel, SPDIF
Integrated Graphics	N/A
Other Features	AI NET AI BIOS CPR CrashFree BIOS2 EZ Flash Instant Music MyLogo2 Multilanguage BIOS POST Reporter Q-Fan InterVideo WinDVDSuite
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com
Price	$172

Performance Comparison		
Benchmark	**AMD Athlon 64 FX-51**	**AMD Athlon FX-53**
3DMark03 Build 340	5286	5327
PCMark04 1.2.0	4432	4770
CPU	4159	4509
Memory	5375	5547
Graphics	4376	4387
HDD	4499	4513
Halo		
800 x 600	54.16fps	54.35fps
1,024 x 768	46.45fps	43.13fps
1,280 x 1,024	31.75fps	32.23fps
Doom 3		
800 x 600	24.4fps	24.4fps
1,024 x 768	17.8fps	17.9fps
1,280 x 1,024	12.2fps	12.2fps


BIOS SETUP UTILITY
Main Advanced Power Boot Exit
System Time [13:55:33]
System Date [Fri 10/22/2004]
Legacy Diskette A [1.44M, 3.5 in.]
Language [English]
Primary IDE Master : [PLEXTOR DVDR PX-]
Primary IDE Slave : [Not Detected]
Secondary IDE Master : [Not Detected]
Secondary IDE Slave : [Not Detected]
System Information
Use [ENTER], [TAB] or [SHIFT-TAB] to select a field.
Use [+] or [-] to configure system Time.
Select Screen
Select Item
Change Field
Tab Select Field
F1 General Help
F10 Save and Exit
ESC Exit

If you want to prevent other users from messing with your carefully overclocked settings, set a password.

Unlike some other boards' BIOSes, the SK8V's BIOS separates the CPU frequency and voltage settings from the memory and AGP settings. You can find these settings in other sections, but overclockers will probably prefer one-stop configuration sections.



find a neighbor or friend with a PC. ASUS traditionally doesn't put much software into its mobo packages, but we're not complaining that this board has InterVideo's WinDVDSuite.

BIOS

ASUS packed the BIOS with features, some of which earn their keep. MyLogo2 (which lets you add a picture to your system's POST screen) and Instant Music Configuration (which lets you play a CD without booting your computer) aren't particularly useful, but overclockers will love CrashFree BIOS 2 and C.P.R (CPU Parameter Recall).

Thanks to CrashFree BIOS 2, you can repair a damaged BIOS, which is almost as good as having a built-in backup BIOS. You can repair the BIOS from CD, or if you have a spare floppy disk handy, from a floppy. We didn't damage our BIOS (we're as surprised as you are), so we can't say that we've actually tried the feature.

We have, however, used C.P.R. When you boot your system after it crashes, C.P.R. kicks in and resets your BIOS to its default settings, which means you don't have to manually clear the CMOS. It didn't catch crashes every time, but it saved us several minutes each time it did.

Another worthwhile feature, though not necessarily an overclocker favorite, is Q-Fan. This feature controls the fans that draw power from the motherboard's connectors, lowering the fan speed (and thus the noise pollution) until the processor takes on heavy tasks that increase its temperature. If you're not planning to overclock your system and want to reduce noise pollution without turning to more expensive cooling alternatives, enable this feature.

One of our favorite features is the ASUS POST Reporter, which gives audible status reports during POST. If you forgot to plug the power cable into your floppy drive, the POST Reporter's friendly voice saves you precious troubleshooting minutes by stating that the floppy drive isn't connected. The feature has tons of messages, including messages that alert you to high CPU temps and failed overclocking attempts, but if you want a different message, you can use the feature's software to record your own. The POST Reporter is disabled by default, so you'll need to enable it in the BIOS. Winbond's Voice Editor software lets you listen to the messages so you can determine which ones you'd like to rerecord.

System Specs

Component	Model
Motherboard	ASUS SK8V
Processor	AMD Athlon 64 FX-51
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL DDDR ECC Reg PC3200 2-3-2-6 OCZ400102-4ELERDC-K
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

Performance

The SK8V cleaned the SK8N's clock as soon as it jumped into the benchmark ring, but oddly enough, it couldn't quite top MSI's server board, the K8T Master2-FAR. That's not to say that the SK8V didn't come close: It consistently gave the MSI board a run for its money. With the FX-51, the board posted a 3DMark03 score of 5286 and a PCMark04 score of 4432. The K8T Master2-FAR beat the SK8V's 3DMark03 score by only 10 points but posted a PCMark04 score of 4481, 49 points higher than the SK8V. The SK8V also scored a whopping 54.16fps in Halo, but its Doom 3 scores weren't any better (or worse) than the other board's scores.

When we popped the FX-53 into our SK8V system, the test PC again pummeled the benchmarks, posting 5327 in 3DMark03 (only eight points behind the K8T Master2-FAR) and 4770 in PCMark04, 10 points ahead of the MSI board. The system also posted strong frame rates in both Halo and Doom 3.

Final Word

Both the SK8V and the SK8N are available for about $172, but unless you're particularly loyal to NVIDIA, you'll probably want to pick up the VIA K8T800-based SK8V. As with the SK8N, the board has a solid extras package and doesn't have much in the way of extra software. However, SK8V has C.P.R., which makes it a much more overclocking-friendly board than the SK8N. We also like the POST Reporter. And although the SK8V didn't quite beat out the MSI board, the SK8V has more features because it doesn't waste space on a second socket. CPU

Overall Rating: CPU CPU CPU CPU

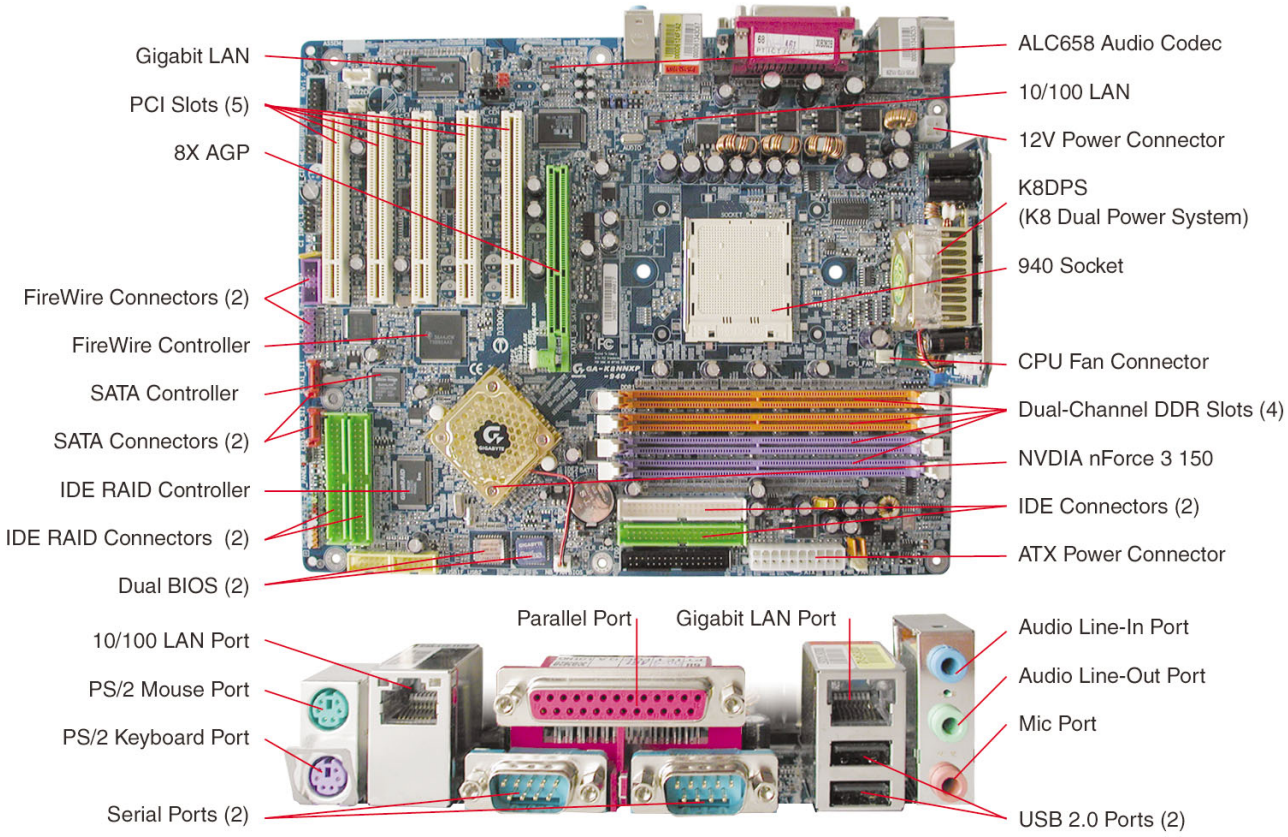
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

GIGABYTE GA-K8NNXP-940

Layout: ATX (Socket 940)

Chipset: NVIDIA nForce3 150



The GA-K8NNXP-940 is a great example of GIGABYTE's penchant for flashy extras that may add value and will certainly jack-up the price. The board, which retails for about $195 (down $34 from our last look at this board in *PC Modder v1.1*), is the most expensive single-socket 940-pin board in this lineup, but it has few items that the less expensive boards don't, including a special add-on card that attempts to stabilize the power flowing to the board, two Ethernet ports, and a windows-based overclocking program.

Chip Talk

As with the ASUS SK8N, the GA-K8NNXP-940 boasts an NVIDIA nForce3 chip, but GIGABYTE chose the standard nForce3 chip instead of the nForce3 Pro that graces the SK8N.

The board's audio codec, Realtek's ALC658 (Pro AC'97 2.3), supports some features that the ALC650 does not, such as EAX, Direct Sound 3D, and Sensaura 3D. We were surprised to see that GIGABYTE chose two LAN chips: a Realtek RTL8201B chip that handles the 10/100Mbps Ethernet port and a Realtek RTL8110S-32 Gigabit controller. Gamers and users who regularly transfer large amounts of data over internal networks will love the Gigabit port's extra speed. The board also boasts a TI TSB82AA2 FireWire 800 controller and a TI TSB81BA3 3-port FireWire cable transceiver, which means you can attach up to three FireWire ports (total) to the two internal connectors. The connector that supports two FireWire ports has an unusual number of pins and requires a special FireWire cable, but GIGABYTE provides one of these.

The GA-K8NNXP-940 also includes a Silicon Image SATA SIL3512 controller and a GigaRAID ATA 133 controller. Thanks to these two chips, the board boasts two SATA connectors and a whopping four IDE connectors and supports RAID 0, 1, and 0+1. We like to see multiple RAID options, but ATA 133 drives are clearly giving way to the faster SATA technology, so we're disappointed that GIGABYTE is making users who have more than two SATA drives resort to PCI adapter cards.

We noticed right away that the motherboard has two BIOS chips. This Dual-BIOS system means that you won't need to repair a damaged BIOS; the backup BIOS takes over when the first dies. It won't prevent your system from crashing, when the first BIOS kicks the bucket, so does your PC. The second BIOS comes to the rescue when you reboot your machine. Our only complaint is that GIGABYTE soldered the chips to the board, which means that if you kill both BIOSes, you're in trouble. We like the removable BIOS chips that grace many modern boards.

GIGABYTE GA-K8NNXP-940	
Socket Type	Socket 940 AMD
Chipset	NVIDIA nForce3 150
Processor Support	Athlon 64 FX, Opteron 100
RAM Support	3GB Registered DDR400/333/26
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	2 (RAID 0,1)
IDE	4 ATA 133
USB Ports	6; 2 external, 2 internal that support 2 each (2.0)
FireWire Ports	3; 2 internal, one of which supports 2 ports
LAN	Realtek 8110S Gigabit, Realtek RTL8201 10/100
Integrated Audio	6-channel, SPDIF
Integrated Graphics	N/A
Other Features	Xpress Installation Xpress RecoveryQ-Flash@BIOSEasy Tune 4 (Windows-Based OC Utility)
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	www.gigabyte.com
Price	$195

Performance Comparison		
Benchmark	**AMD Athlon 64 FX-51**	**AMD Athlon FX-53**
3DMark03 Build 340	5235	5280
PCMark04 1.2.0	N/A	N/A
CPU	N/A	N/A
Memory	N/A	N/A
Graphics	N/A	N/A
HDD	N/A	N/A
Halo		
800 x 600	53.27fps	54.87fps
1,024 x 768	45fps	46.48fps
1,280 x 1,024	30.98fps	31.59fps
Doom 3		
800 x 600	24.4fps	25.1fps
1,024 x 768	17.8fps	17.9fps
1,280 x 1,024	12.1fps	12fps

Layout

All in all, we like the GA-K8NNXP-940's layout. Normally, we don't like to see power connectors on the left side of the board, as it means you'll have to stretch the fat power cords over and around important components, but we don't mind the 12V connector at the top left of the board. Thanks to a long, blue add-on card slot just above the CPU, you can string the cable to it without blocking anything. The 20-pin ATX connector stands at the top right of the board, next to two of the four IDE connectors. The other two IDE connectors stand near the bottom right of the board, just under the lone nForce3.

GIGABYTE colored two of its dual-channel memory slots orange and colored the other two purple. Each pair has an A and B channel, which means you'll want to put your two identical DIMMS into the orange or purple slots.

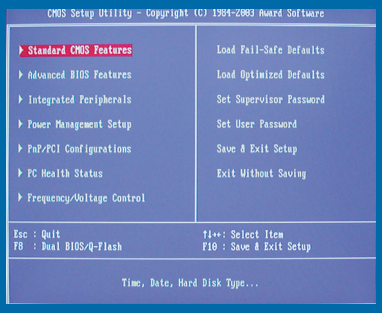
Despite the brightly colored memory slots and brightly shining chipset heatsink, you'll notice the K8DPS (K8 Dual Power System) before you notice anything else. The K8DPS card, which plugs into the special riser near the top of the board, boasts a three-phase power circuit that complements the motherboard's three-phase circuit. The K8DPS card includes a heatsink and an LED fan (we're surprised GIGABYTE didn't also put LEDs on the northbridge heatsink fan). Although the fan extends almost to the CPU's retention frame, it didn't cause any trouble when we installed the CPU heatsink.

We were a little nervous when we saw the K8DPS: Although the feature should mean that the system can handle currents up to 150A, we fried two identical GIGABYTE GA-K8VNXP (Athlon 46, socket 754) boards when we reviewed them for *PC Modder v1.1*. As soon as we raised the earlier boards' voltage to 1.6V, they emitted smoke. Afterward, we found burn marks on the backs of both boards. GIGABYTE told us that it's never heard of this problem before, and we didn't have any trouble when we overclocked the GA-K8NNXP-940 for the same issue, so we suspected that the burnouts were flukes, or at least unique to the GA-K8VNXP series, but we were cautious anyway when we finally raised the voltage. As it turned out, the board didn't burn, but it also wouldn't let us overclock and crashed whenever we ran PCMark04's memory test. Unfortunately, the BIOS doesn't have any memory settings. As it turns out, GIGABYTE tells us that some of its boards have trouble with AMD's memory controller. It is releasing BIOS updates that fix this problem, but it won't get to the GA-K8NNXP-940 right away, as the FX series recently switched to 939-pin processors.

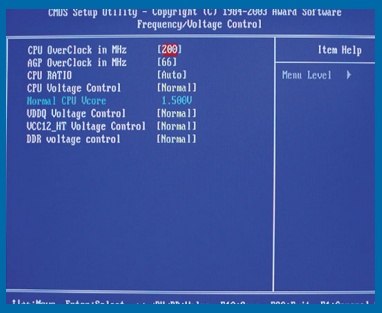
If you've never seen GIGABYTE's plastic retention frame and backplate combo, you may have some trouble installing it. Unlike most retention frames, this frame uses white plastic plugs. To attach the frame, extend the plug handles, press the retention frame against the board's holes, and then press the handles back into place.

Extras

Without a doubt, GIGABYTE takes its extras seriously. As far as documentation



The Dual BIOS/Q-Flash utility lets you customize your dual-BIOS backup system.


CMOS Setup Utility - Copyright (C) 1984-2003 Award Software
Frequency/Voltage Control
CPU OverClock in MHz [200]
AGP OverClock in MHz [66]
CPU RATIO [Auto]
CPU Voltage Control [Normal]
Normal CPU Vcore 1.500V
VDDQ Voltage Control [Normal]
VCC12_HT Voltage Control [Normal]
DDR voltage control [Normal]
Item Help
Menu Level

The BIOS has plenty of CPU settings, but it doesn't have any memory settings.

goes, we found two separate RAID manuals (one for the SIL3112 SATA chipset and one for the IT8212 ATA RAID chipset), a detailed (but somewhat confusing) mobo manual, a handy crib sheet that labels various board components and the front-panel connectors, and an installation poster that walks you through the basics. Whew.

We were surprised to see that GIGABYTE tossed a few ugly, yellow IDE cables into the package. But we like the other items, which include two SATA data cables with dust caps, two SATA power cable adapters, and four D-brackets: an audio port bracket with SPDIF ports, a dual USB bracket, a USB/FireWire bracket, and a bracket that lets you extend your SATA ports to the system's back panel.

Of course, the best extra is Easy Tune 4, which is GIGABYTE's overclocking software. The software didn't achieve the same clock speeds or benchmark scores that the BIOS brought home, but it's not meant to be a better overclocker. Instead, the software acts as a playground for newbies. Afraid of the BIOS? Then skip it and load Easy Tune 4 in Windows. You can use the software to check fan speeds and equipment temperature, raise the CPU and video card clock speed, and change the multiplier, all without rebooting your system. (Unless, of course, it crashes. No one said this playground was safe.)

System Specs

Component	Model
Motherboard	GIGABYTE GA-K8NNXP-940
Processor	AMD Athlon 64 FX-51
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL DDDR ECC Reg PC3200 2-3-2-6 OCZ4001024EL ERDC-K
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

BIOS

Although you'll use the arrow keys to select most of the main menu's categories, you'll press F8 to enter the BIOS' update and backup utilities. This section houses the Dual BIOS feature's options, which let you enable or disable Auto Recovery. It also houses Q-Flash, a feature that lets you update the BIOS without booting into Windows.

We were surprised to see that the BIOS doesn't include any memory settings. The Frequency/Voltage Control section lets you raise the memory voltage, but that's it. Thanks to the lack of settings, you can't overclock your memory at all. However, the BIOS has several overclocking settings, including CPU and AGP frequency settings, CPU and memory voltage controls, and a CPU multiplier field. The CPU voltage setting lets users choose from a range of 0.8V to 1.7V. We're glad to see the high voltage range; some BIOSes won't let users raise the voltage past 1.55V.

The PC Health Status section lists your system's voltages, fan speeds, and the CPU's temp. This section also has several Fan Fail Warning fields and a CPU Warning Temperature field that lets you choose a limit for the CPU's temp.

Performance

Although the GA-K8NNXP-940 didn't like PCMark04's memory suite, it posted strong scores in 3DMark03 with both the AMD Athlon 64 FX-51 and the Athlon 64 FX-53. It lagged a little behind the MSI K8T Master2-FAR in 3DMark04, posting 5235 with the FX-51 and 5280 with the FX-53 (the K8T Master2-FAR scored 5296 and 5335, respectively) but then, the GA-K8NNXP-940 has more features.

The GA-K8NNXP-940 also handled the game benchmarks well, posting high frame rates in both Doom3 and Halo. We're not excited to see the board doesn't play nicely with some FX processors, but we're not surprised that GIGABYTE is focusing on other BIOS updates before it updates the dead-end Socket 940-based board. However, don't despair if you're planning to buy or already have this board: Although GIGABYTE doesn't know when it will release the fix, it does intend to release a BIOS update.

Final Word

Despite lacking memory settings and not liking the FX processor's memory controller, the board has several strong features, including the DPS and the solid extras package. The board also posted strong scores in all of the benchmarks that it completed. If you're considering this board, we suggest waiting until the new BIOS (F3, which does not include the memory controller patch, is the current version) removes the Achilles' heel from this otherwise solid player. CPU

Overall Rating: CPU CPU CPU CPU

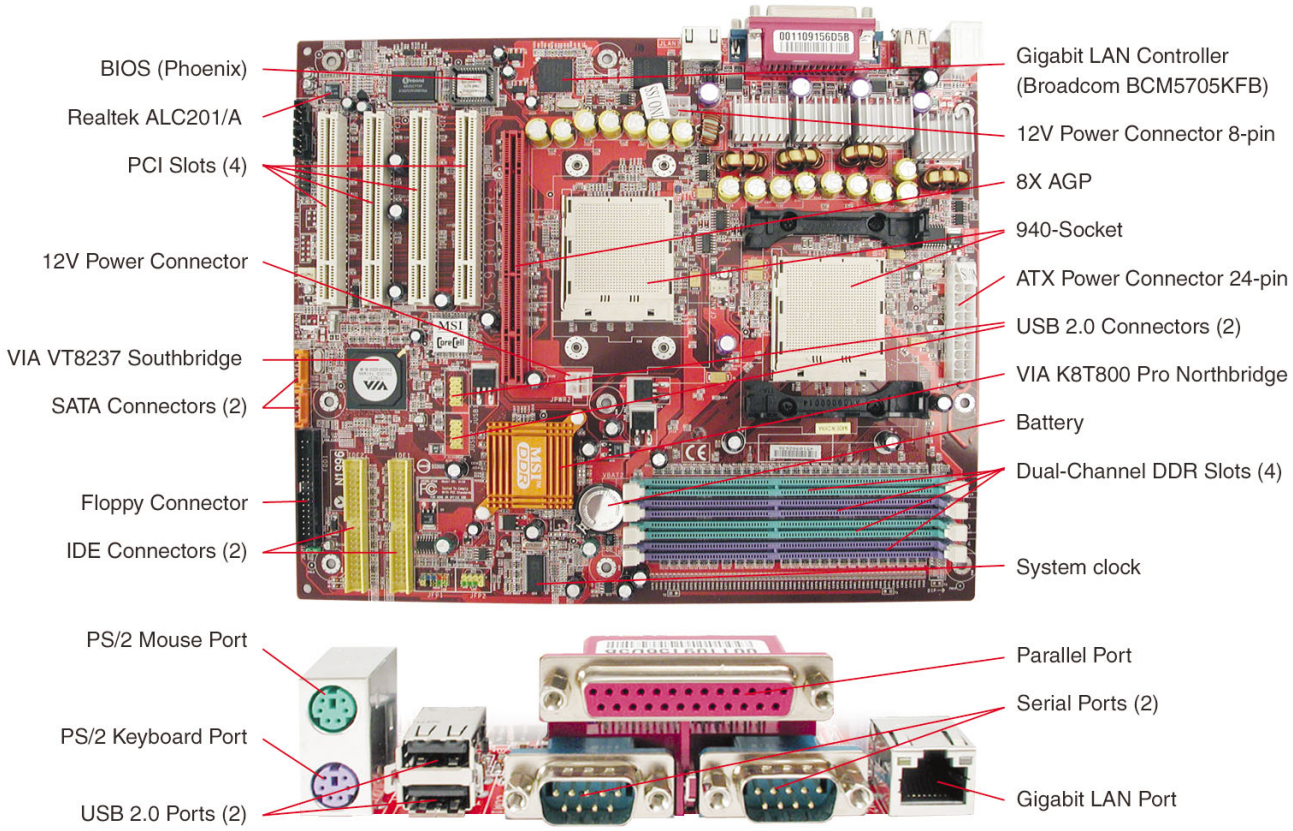
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

MSI K8T Master2-FAR

Layout: ATX (Socket 940)

Chipset: K8T800 Pro, VT8237



As we've mentioned in previous mobo reviews, the Athlon FX, AMD's high-end enthusiast processor, is a direct descendant of the Opteron workhorse. With its latest model, the FX broke away from the Opteron—the socket 939 FX-53 doesn't require the registered memory on which the 940-pin FX-51, FX-53, and Opterons rely. As a result, many motherboard manufacturers didn't bother to support the short-lived 940-pin FX.

MSI is one of the few mobo makers that didn't skip the FX's early stages. The Opteron-friendly, dual-socket Master2-FAR also supports an FX processor. If you're interested in the board's Opteron support, check out our MSI K8T Master2-FAR dual Opteron review on page 115.

Chip Talk

Although the board's extra CPU socket instantly sets it apart from the other FX boards we've reviewed, it has many familiar features and chips, including the VIA K8T800 Pro northbridge and VT8237 southbridge. We're not surprised to see the K8T800 Pro on this board, which works with both Opteron and FX processors, nor are we surprised to see the same southbridge that accompanies the ASUS SK8V's K8T800 Pro, which took advantage of this chipset's capabilities; but we're not sure MSI made great use of either chip.

For one thing, MSI stuck the northbridge behind the AGP slot, which means that large cards hang over the chip. The northbridge's heatsink is slim, so we're not worried that a video card will bump it, but the chip's location presents the same problem to K8T Master2-FAR owners that ASUS SK8N owners experience: You can't

replace the heatsink with a heatsink/fan combo unless you have a low device.

As far as the southbridge, we were surprised to see that MSI added only two external and two internal USB 2.0 connectors (each of the internal connectors support two USB ports via expansion modules, such as the included USB D-bracket or your case's front panel connector), which means the board has a total of six ports; two fewer than the southbridge supports. Also, the chip supports six PCI slots, but MSI didn't even include the standard five slots: The board has four.

We were glad to see that MSI added a Broadcom BCM5705KFB Gigabit LAN controller, but we tried not to snicker when we saw that the most expensive board in our roundup has a two-channel Realtek ALC201/A (Advanced AC'97) audio codec. Thanks a bunch, MSI.

MSI K8T Master2-FAR	
Socket Type	Socket 940 AMD (x2)
Chipset	VIA K8T800 Pro, VT8237
Processor Support	Athlon 64 FX, Opteron 100 (1 processor) and Opteron 200 (2 processors)
RAM Support	8GB Registered DDR400 (FX Only) /333/266/200
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	4
SATA Ports	2 (RAID 0, 1)
IDE	2 ATA 133
USB Ports	6; 2 external, 2 internal that support 2 each (2.0)
FireWire Ports	0
LAN	Broadcom BCM57-05KFB Gigabit
Integrated Audio	2-channel
Integrated Graphics	N/A
Other Features	Adobe Photoshop Album 1.0 Fuzzy Logic Live Update PC Alert RestoreIT WinDVD 4 WinRip 2 VirtualDrive
Manufacturer	MSI
Phone	(626) 913-0828
URL	www.msicomputer.com
Price	$215

Performance Comparison		
Benchmark	**AMD Athlon 64 FX-51**	**AMD Athlon FX-53**
3DMark03 Build 340	5296	5335
PCMark04 1.2.0	4481	4760
CPU	4189	4509
Memory	5392	5571
Graphics	4542	4567
HDD	4563	4518
Halo		
800 x 600	53.66fps	55.6fps
1,024 x 768	45.05fps	46.87fps
1,280 x 1,024	31.02fps	31.78fps
Doom 3		
800 x 600	24.4fps	25.2fps
1,024 x 768	17.8fps	17.9fps
1,280 x 1,024	12.1fps	12fps

Layout

MSI adds its CoreCell chip (which controls some BIOS fan control tweaks) to many of its motherboards, so we weren't surprised to see it just behind the PCI slots. The board has two IDE ports and two SATA ports, which is fine by us. We'd prefer more SATA ports, but we're glad MSI didn't waste space with IDE ports. MSI tucked most of the capacitors between the I/O port area and the CPU sockets.

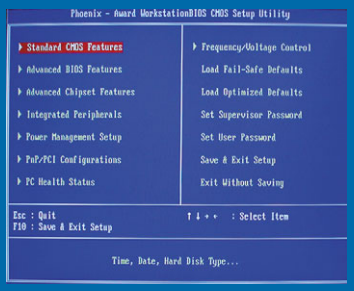
Unfortunately, MSI placed the ATX power connector at the top of the board, above the top CPU socket. As a result, we had trouble keeping our stiff power cable out of the way of the CPU fan. To make matters worse, one of the 12V connectors stands at the far left of the board, just behind the I/O port area. You'll need to snake your power cables between the two CPUs to reach this connector. The other connector, which stands near the back of the AGP slot, powers your AGP card.

You may already know that dual-socket boards often require slightly different power supplies than standard desktop PCs. PSUs and motherboards that meet Intel's SSI specification have 24-pin ATX connectors and 8-pin 12V connectors. The K8T Master2-FAR meets SSI specifications, but it doesn't demand the unusual power supply. MSI wrapped SSI ONLY stickers over certain connector holes, which means that users who have standard PSUs can plug their cables into the remaining connector holes to power the system, whether they use a single FX or dual Opterons.

The lower CPU socket stands extremely close to the AGP slot. You can't plug a standard retention frame into the socket's four holes, so MSI tosses two special heatsinks into the package. That's right—the board includes its own heatsinks. The top socket's heatsink resembles other standard copper heatsinks, but it has a retention frame that won't accept other heatsinks. However, things get really weird when you get to the socket that crowds the AGP slot. This socket's heatsink skips the retention frame and uses four screws that have large springs. The most unusual part of the heatsink is its fins; where most sinks have fins that span the top of the heatsink, this device's fins extend to the screws on one side. Thanks to this design, even AGP cards that have their own heatsinks won't bump into the CPU heatsink and fan.

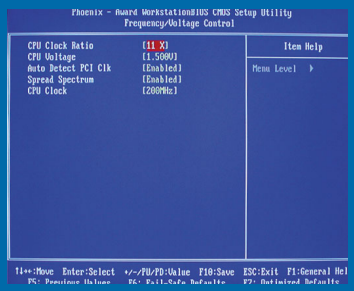
Although many users will probably build servers and workstations around this board, MSI doesn't ignore the users who want to toss an FX into one of the sockets and push the high-end processor as far as it can go. Thanks to MSI's new CoreCenter Pro software, you can overclock your system without entering the BIOS. The center of the CoreCenter's UI displays your FSB and the CPU multiplier, as well as the clock speed. The UI's center "wings" display system information, including fan speeds, temperatures (the board calculates the CPU temp based on load—it doesn't use a temp sensor), and voltages including AGP, memory, and Vcore voltages.

Overclockers and users who are worried about heat problems will like the UI's two extra wings, which extend beyond the first wings. The right wing lets you set temperature and fan speed alarms. Each setting has



Keep in mind that the FX-series doesn't require your registered memory's ECC feature. You can boost performance by disabling it in the Advanced Chipset Features section.

We like BIOS overclocking sections that house most of the system's frequency and voltage settings, such as the K8T Master2-FAR's Frequency/Voltage Control menu.



a slider bar that lets you quickly choose a fan speed or temp. The left wing has the OC features: You can adjust the FSB, the memory voltage, and the AGP voltage. CoreCenter overclocks the system on the spot, which means you won't need to reboot your PC unless you crash it.

Your system returns to default settings as soon as you reboot Windows, but thanks to the Save feature, you can easily restore your overclocked settings. Simply open CoreCenter and load the overclock profile.

Extras

The K8T Master2-FAR doesn't have as many extras as enthusiast-oriented boards, but it doesn't leave users out in the cold, either. The package includes two SATA data cables with dust caps, IDE and floppy cables, and a D-bracket that boasts two USB ports and the three audio ports that the I/O port area lacks. As with many of the boards we've reviewed, the package doesn't include SATA drivers; you'll need to find the appropriate drivers on the CD and then transfer them to a floppy. The package also includes a decent software CD that boasts Adobe Photoshop Album SE, Media Ring, RestoreIT! 3, VirtualDrive 7, WinRip 2, and WinDVD 4.

System Specs

Component	Model
Motherboard	MSI K8T Master2-FAR
Processor	AMD Athlon 64 FX-51
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL DDDR ECC Reg PC3200 2-3-2-6 OCZ4001024-ELERDC-K
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

BIOS

The DELETE key opens the K8T Master2-FAR's BIOS during POST. As with most Phoenix BIOSes, the main menu features a Frequency/Voltage Control category that handles most of the overclocking settings, including the CPU frequency. It doesn't have memory settings; they're under DRAM Configuration in the Advanced Chipset Features menu.

The BIOS also has a full PC Health Status section that lists fan speeds and temps and has a few alert features, such as Smart CPU Fan, which lets you know when the temp exceeds a certain limit. Of course, your PC may be in trouble by the time it triggers the warning, so if you're cautious, you can enable another feature in this section that will shut down your PC when it exceeds the temp limit.

Performance

The K8T Master2-FAR may be a server board at heart, but this dual-socket beast makes a fine Athlon 64 FX board. The mobo posted excellent 3DMark03 and PCMark04 scores with both FX processors. The K8T Master2-FAR/FX-53 combo fared particularly well, posting 5335 in 3DMark03 and 4760 in PCMark04. The board also posted strong frame rates in Doom 3 and Halo; the Master2-FAR/Athlon 64 FX-53 combo posted a whopping 55.6fps at 800 x 600 and 46.87fps at 1,024 x 768 resolution in Halo.

The K8T Master2-FAR/Athlon 64 FX-51 also performed well, but it didn't stomp the benchmarks as soundly as the higher-end combo. The system produced a solid 5296 in 3DMark03 and 4481 in PCMark04, but it only barely beat out the GIGABYTE GA-K8NNXP-940 when it posted 53.66fps at 800 x 600 in Halo (the GIGABYTE board produced 53.27fps), and it essentially broke even with GIGABYTE's mobo at 1,024 x 768: The K8T Master2-FAR posted 45.05fps, and the GA-K8NNXP-94 posted 45fps.

Final Word

The K8T Master2-FAR isn't particularly sleek, but it does have two great copper heatsinks, which is more than other motherboards can claim. Unfortunately, MSI gears the board more toward server and workstation builders than enthusiasts: The board doesn't have FireWire and has only two external USB ports. Also, it's extremely expensive (about $215), thanks to the second CPU socket and those heatsinks. Unless you're fanatically brand-loyal or building a two-Opteron board, you're probably better off with a standard, single-socket mobo.

Although this board lacks some of the features that other boards offer, such as external audio ports and FireWire ports, it boasts solid performance, and if you buy a pair of Opterons, it can power your next server or workstation. CPU

Overall Rating: 4.5

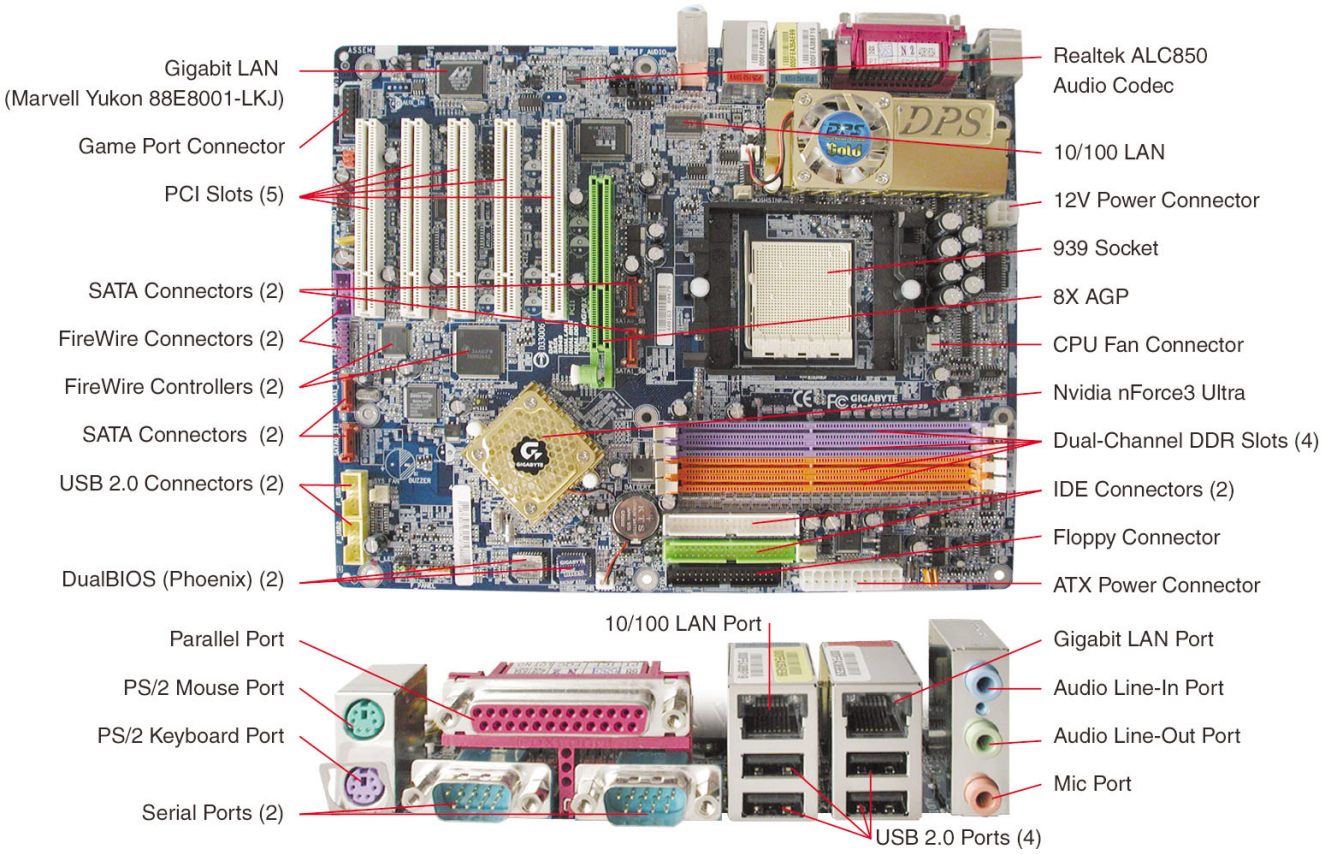
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

GIGABYTE GA-K8NSNXP-939

Layout: ATX (Socket 939)

Chipset: NVIDIA nForce3 Ultra



Now that the FX processors, starting with a second version of the FX-53, use the 939-pin architecture, users won't need to invest in the expensive registered memory that socket 940 CPUs required. Another bonus is that standard Athlon 64s also have 939 pins, which means you can buy an Athlon 64 and motherboard now and then upgrade to an FX later without replacing the mobo.

If you have a 940-pin FX-53, you have one of the fastest processors around, but you've reached the end of the line, at least as far as your motherboard is concerned. We don't expect AMD to release any new 940-pin FX processors, so read on to learn about a board that may be your next upgrade.

Chip Talk

As with the NVIDIA nForce2, which graces some Socket 940 boards, the nForce3 Ultra consists of a single chip instead of the standard northbridge/southbridge chipset. Unlike the nForce2, the new chip generally has a heatsink/fan combo. GIGABYTE dropped the fan into the center of the heatsink to conserve space; the chipset sits behind the AGP slot. However, it doesn't stand as close to the slot as the nForce2 did, which means your video card may not hang over it at all. The chip supports RAID 0, 1, 0+1, and Gigabit Ethernet. It also has a built-in Firewall, so the single-chip design certainly doesn't mean fewer features.

Two chips support the nForce2's LAN feature: an ICS 1883AF PHY (10/100Mbps) and a 32-bit Marvell Yukon 88E8001-LKJ Gigabit controller. The board also includes the new Realtek ALC850 (AC'97 2.3) audio codec, which

System Specs	
Component	**Model**
Motherboard	GIGABYTE GA-K8NSNXP-939
Processor	AMD Athlon 64 3500+
Processor	AMD Athlon 64 3800+
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

boasts 8-channel surround sound, and two FireWire chips support the two FireWire 800 connectors, which in turn support up to three ports: the TI TSB82AA2 controller and the TSB81BA3 transceiver.

The nForce3 Ultra handles the two SATA connectors that stand just above the AGP slot, while a Silicon Image SATALink Si3512 handles the two SATA connectors at the bottom of the board. An ITE IT8712 chip controls a bunch of I/O connectors, including floppy, game, and PS/2 connectors.

Layout

The GA-K8NSNXP-939 is nothing if not classy. From its orange-and-purple memory sockets to its red SATA connectors to its green AGP slot, the dark blue board has plenty of color, and that's before we get into the bling-bling. The brass-colored, anodized aluminum DPS (Dual Power System) Gold has bright blue lights.

Unlike the previous DPS system, which took the form of add-on cards that plugged into a PCI slot-like riser just above the CPU socket, the new DPS Gold is an almost permanent part of the board. If you really don't want the device, you can remove it; it attaches to the board via plastic clips. That said, we can't imagine you wanting to take off the DPS as it won't block most heatsinks. Another reason not to toss it is the stability the device provides. The DPS adds a three-phase power circuit to your board's built-in three-phase circuit. We prefer the new DPS device, which sits out of the way between the CPU socket-retention frame and the I/O port area.

The four dual-channel memory sockets stand vertically on the board, but you won't have to worry about stretching cables over them as the 20-pin ATX power connector stands on the right edge of the board. The 12V connector is above the CPU socket, but as the DPS isn't in the way, you can easily snake the cable past the capacitors.

GIGABYTE lined most of its port connectors, including the USB 2.0 and FireWire, along the bottom of the board, which leave the rest of the board free of cables, unless you plug your SATA data cables into the two connectors near the AGP slot. Even then, you won't need to run the cables over sensitive components.

We like the AGP card's plastic locking mechanism, which snaps over the video card's hook and then pulls back to release it. This is worth noting because the traditional locking mechanism is hard to reach, especially on mobos that have nearby capacitors or heatsinks. Unfortunately, GIGABYTE also used plastic tabs to lock the retention frame into the plastic backplate. Good luck removing those without ruining the tab.

GIGABYTE also included its Easy Tune 4 overclocking utility. The Windows-based software has a gaudy UI that displays the CPU multiplier, system bus, processor clock speed, and AGP and memory voltages. This main page has several collapsible sections, including one that boasts more detailed temp and fan speed information and a section that houses a voltage feature.

We like the Hardware Monitoring section, which lets you set alarms for high temps, but most users will like EasyTune for its overclocking capabilities. Enter a new clock speed or voltage, press the big red Go button, and watch EasyTune 4 overclock your system. If you've never used software to overclock a system before, you'll be surprised to find that you can overclock without rebooting the system. Another plus is that you can save your OC settings so you can restore them quickly when you want to handle CPU-intensive tasks. Unfortunately, the utility doesn't permanently overclock your PC; the system returns to default settings when you reboot it.

Extras

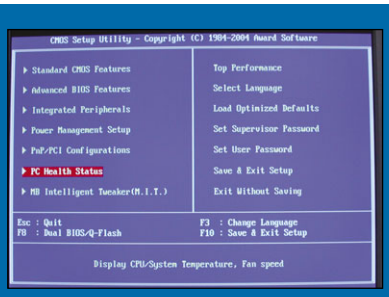
The GA-K8NSNXP-939's strong extras package includes color-coded IDE and floppy cables, which have tabs that act as handles.

You'll also find three SATA data cables with dust caps, two SATA power supply adapters that support up to three hard drives, a D-bracket that extends two of the internal SATA connectors to the back of the case, a four-port FireWire USB D-bracket, a two-port USB D-bracket, and an audio D-bracket that includes RCA Out and SPDIF Out ports. The documentation includes a SATA RAID manual, an installation poster, and the board's manual. Unfortunately, GIGABYTE omitted a floppy that has SATA drivers. The drivers are on the included CD.

BIOS

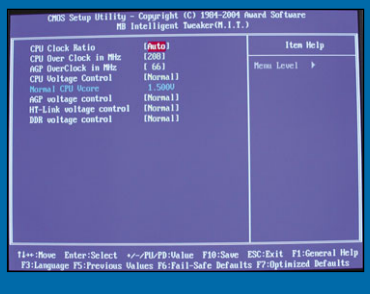
As usual, GIGABYTE gave the board two BIOS chips, both of which contain the same Phoenix BIOS. This DualBIOS

GIGABYTE GA-K8NSNXP-939	
Socket Type	Socket 939 AMD
Chipset	NVIDIA nForce3 Ultra
Processor Support	Athlon 64, Athlon 64 FX
RAM Support	4GB DDR400/333/266
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (RAID 0,1, 0+1)
IDE	2 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	2 internal
LAN	Marvell 88E8001-LKJ Gigabit, ICS 1883 PHY 10/100
Integrated Audio	8-channel, SPDIF
Integrated Graphics	N/A
Other Features	GoldEasyTuneQ-FlashXpress InstallationXpress Recovery
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	www.giga-byte.com
Price	$205



Press DELETE during POST to enter the GA-K8NSNXP-939's BIOS.

GIGABYTE's MIT (MB Intelligent Tweaker) houses the most important overclocking settings, including the CPU and AGP frequency fields.



system averts disaster by activating the backup BIOS as soon as you damage the BIOS by crossing your board's overclocking limits. Of course, this isn't an overclocker-only feature: You can accidentally damage your BIOS when you flash it. You can enter the Dual BIOS Utility by first entering the BIOS (press DELETE during POST) and then pressing F8. We didn't expect the Dual BIOS Utility to have many settings, so we were surprised to see that the main menu has about a dozen options. You can disable the Auto Recovery feature or specify which BIOS will back up the other.

The BIOS includes a MIT (MB Intelligent Tweaker) section that houses the most important speed and voltage options. Some BIOS overclock features offer wide ranges: The CPU Voltage Control feature, for example, lets you choose between 200 and 300MHz in 1MHz steppings.

We like fields that offer small steppings. Small CPU voltage steppings are crucial, so we like that the BIOS lets you raise the voltage a mere 0.025V at a time. We're also glad to see that this field offers a reasonably wide range: from 0.8 to 1.7V. We prefer higher settings, but we'll take a 1.7V max over the 1.55V max that some boards offer. This section lets users adjust the AGP voltage and the DDR voltage. Users can also overclock the AGP voltage up to 100MHz.

The BIOS also offers an excellent PC Health Status category. The section displays voltages, temperatures, and fan speeds, but unlike many PC Health sections, it boasts several adjustable fields, including a CPU temp alert and three fan alerts. The CPU Warning Temperature has a large alert range: 60 degrees Celsius to 90 C, but it has 10-degree steppings, which means you really have only four choices. Each fan alert has only two options: Enabled or Disabled.

Performance

At stock settings, the GIGABYTE GA-K8NSNXP-939 just barely beat out MSI's nForce3 Ultra board, the K8N Neo2 Platinum Edition. With the AMD Athlon 64 3500+ at the helm, the GIGABYTE board posted a 3DMark03 score of 5239 and a PCMark04 score of 4343, just topping the K8N Neo2's scores of 5235 and 4324 (3DMark03 and PCMark04, respectively). The GA-K8NSNXP-939 provided higher 3DMark03 scores than its MSI counterpart when we tested two other processors (the AMD Athlon 64 3800+ and the AMD Athlon 64 FX-53), but it failed to take more than a four-point lead.

The board fared a little worse when it ran PCMark04: Only the 3500+ produced better scores on the GA-K8NSNXP-939 than on the K8N Neo2. That said, the GIGABYTE board isn't a slouch; it never lagged more than 18 points behind the K8N Neo2. The GA-K8NSNXP-939 broke even with the MSI board when we ran the Doom 3 and Halo benchmarks.

Next, we jumped into the BIOS and pumped up the GA-K8NSNXP-939's frequency. The board responded immediately, producing solid 3DMark03 and PCMark03 increases. The mobo loved the overclockable FX-53, pushing it up to 213MHz (2.55GHz) without any trouble. We couldn't quite push it to the K8N Neo2's 2.5GHz mark, but we're not complaining about the GIGABYTE board's 251-point PCMark04 score increase.

Performance Comparison

Benchmark	AMD Athlon 64 3500+	AMD Athlon 64 3800+	AMD Athlon 64 FX-53	AMD Athlon 64 FX-53 2.4GHz at 2.55GHz,1.6V
3DMark03 Build 340	5239	5281	5290	5323
PCMark04 1.2.0	4343	4664	4679	4930
CPU	4099	4449	4459	4721
Memory	5191	5382	5490	5757
Graphics	4556	4574	4571	4601
HDD	4287	4288	4298	4366
Halo				
800 x 600	49.65fps	51.43fps	52.58fps	54.14fps
1,024 x 768	44.94fps	45.84fps	47.13fps	47.65fps
1,280 x 1,024	31.49fps	31.61fps	32.08fps	32.1fps
Doom3				
800 x 600	24.3fps	25.1fps	25.1fps	24.5fps
1,024 x 768	17.8fps	17.8fps	17.9fps	17.9fps
1,280 x 1,024	12.1fps	12fps	12fps	12fps

Final Word

The GA-K8NSNXP-939 makes a great board at stock and overclocked settings. Although it has several great features, including the DPS Gold system support for RAID, we can't ignore the $205 price tag. The K8N Neo2 doesn't have a special SATA extension module or an extra power circuit device, but it costs about $70 less and offers (ever so slightly) better benchmark scores. CPU

Overall Rating: CPU CPU CPU CPU

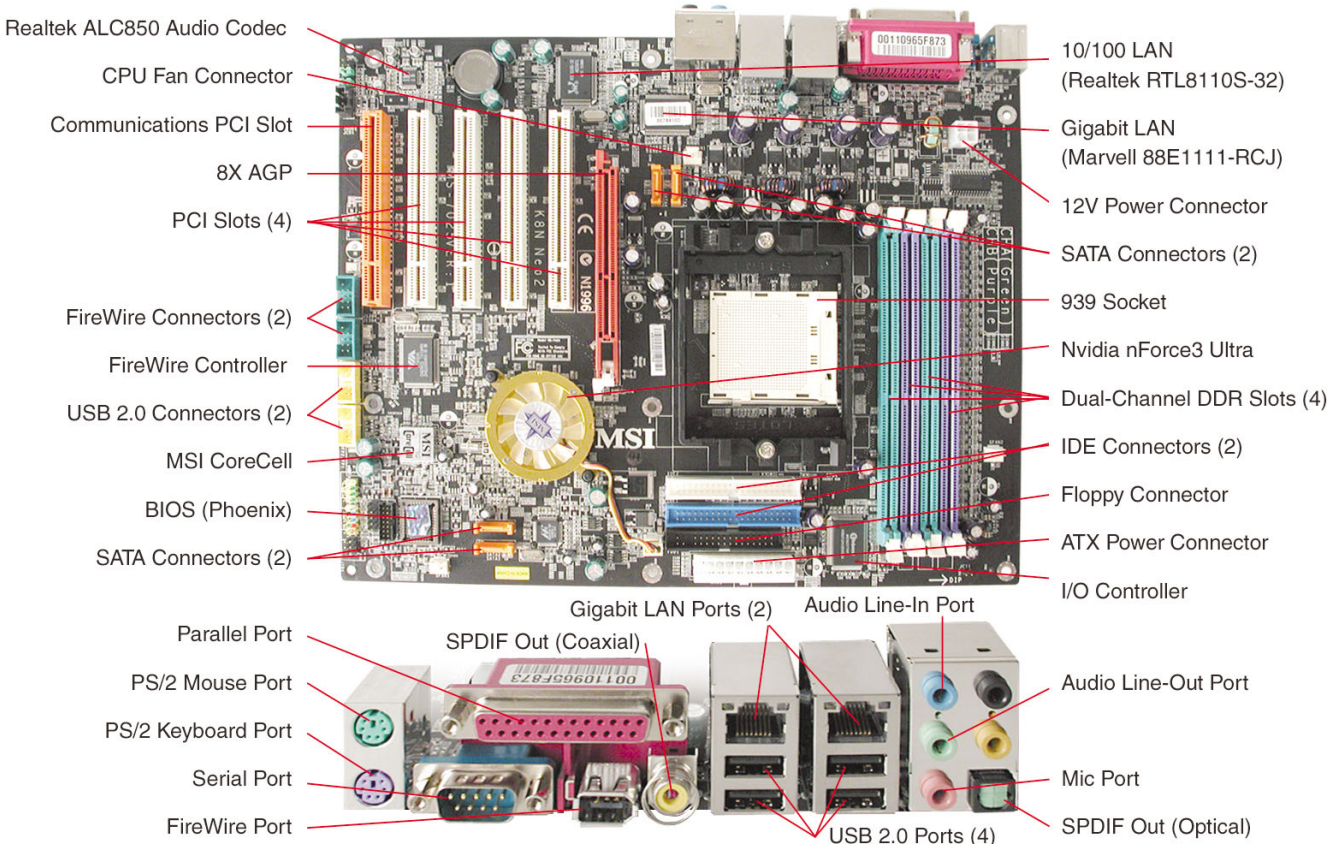
by Joshua Gulick

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

MSI K8N Neo2 Platinum Edition

Layout: ATX (Socket 939)

Chipset: NVIDIA nForce3 Ultra



With the K8N Neo2 Platinum Edition, MSI finds a middle ground between aesthetics and usefulness: The board's components have multiple colors that indicate connector types and memory slot channels and the PCB itself has a sleek black look that makes the whole board look classy.

Chip Talk

As with GIGABYTE's GA-K8NSNXP-939, the MSI K8N Neo2 Platinum Edition sports NVIDIA's relatively new nForce3 Ultra chipset, er chip. That's right, you can forget all about the northbridge/southbridge model: The nForce3 Ultra consists of a single chip that handles both chips' features. The chipset stands near the AGP slot, but unlike the GIGABYTE motherboard's chip, this nForce3 doesn't stand directly behind the slot.

The nForce3 Ultra supports Gigabit LAN, so MSI took advantage of the feature by slapping two Gigabit controllers onto the black PCB: a Marvell 88E1111-RCJ chip and a Realtek RTL8110S-32 chip. We're glad to see MSI thumbing its nose at stingy board makers who use 10/100 controllers, which don't take advantage of the nForce3 Ultra's speed. Don't get us wrong: We're always glad to see two LAN ports, even if one is 10/100.

MSI also scores points with the Realtek ALC850 (AC'97 2.3) audio codec. The new codec delivers crisp

sound and offers eight channels. We appreciate that the board has four SATA ports, two of which communicate via a Marvell 88SR3020 SATA controller. The board also sports a VIA VT6306 FireWire controller, a Winbond W83627THF I/O controller, and MSI's CoreCell, which handles fan control features.

Layout

Four of the board's five PCI slots are beige and the last slot is orange. Thanks to some nonstandard PCI 2.3 definitions, MSI's DigiCell software recognizes this particular slot: If you have MSI's optional PCI Wi-Fi card, you can plug it into the orange slot and then use DigiCell to access the card's settings (the Wi-Fi card isn't in the package, unfortunately).

Four dual-channel DDR memory slots stand horizontally above the CPU socket. The slots alternate between green and purple to indicate each slot's channel (channel A is green and channel B is purple). If you have two identical, double-sided DDR DIMMS and want to take advantage of the board's dual-channel technology, you'll want to put one DIMM in the green slot closest to the CPU socket and the other DIMM into the next (purple) slot. The manual has a chart that displays DIMM placement based on DIMM speed and whether the memory is single-sided (has memory modules on only one side) or double-sided.

However, a row of capacitors stands about 2mm from the CPU socket's retention frame hooks. As a result, you'll probably want to position the CPU heatsink so that the clip that has the locking mechanism faces the other direction, toward the IDE ports. We didn't have any trouble attaching and removing the heatsink, so we can't complain. Although AMD's new stock heatsinks aren't nearly as stiff as the older models, you'll still need to apply some pressure to the clips to force them over the CPU socket hooks.

Most of the internal connectors, including the front panel, USB, FireWire, and audio connectors line the bottom of the motherboard, which means you can easily run cables to them. MSI placed two of the SATA connectors on the right side of the board, but it placed the other two just above the AGP slot, which means you'll need to snake the SATA data cables past a few capacitors. We like the K8N Neo2 Platinum Edition's packed I/O area, which boasts seven audio ports, including both optical and coaxial SPDIF-out ports.

Extras

The K8N Neo2's great extras package includes two orange SATA data cables with dust caps, a SATA power connector adaptor that supports two hard drives, a rounded IDE cable, and a rounded floppy cable. Both of the latter cables have red, thick rubber casings and the IDE cable has pull tabs that let users easily remove the connectors. The package includes a single expansion module that houses two USB ports and four Diagnostic LEDs that flash system status and error codes during POST. If you're having trouble starting your system, you can use the module to troubleshoot.

Of course, one of our favorite items is the floppy that has Windows XP SATA drivers. Thanks to the disk, you won't need to extract the drivers from the mobo CD to a floppy.

The driver CD also includes MSI DigiCell, which is a suite of small applications, such as Live Update (a Windows-based BIOS and mobo-driver update utility) and Core Center. This program displays your system's vital stats, such as CPU temp and fan speed, and lets you change the FSB and certain component voltages. It also lets you save overclock settings, which means that you can leave your system at normal settings until you want to start a CPU-intensive task or video game, at which point you can load your overclock settings.

You can also enable Cool'n'Quiet from the CoreCenter. This feature monitors your CPU's activity and adjusts fan speeds to match. As a result, your system fan runs slower (and quieter) when your PC is idle or not under a full load. The feature has a User Mode option that lets you choose from several fan speeds.

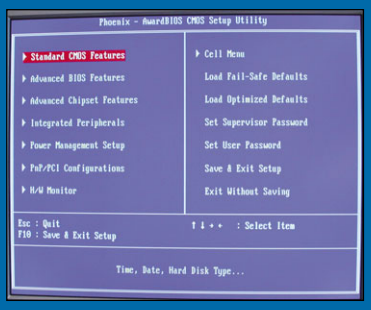
BIOS

We like the Phoenix Cell Menu, which houses the speed and voltage settings. Unlike most BIOSes, which separate memory timings from more popular overclocking settings, such as the FSB and Vcore voltage, Cell Menu has everything an overclocker needs. We noticed that the menu includes two automatic overclocking tools—if you want to boost your system's performance without spending hours and hours inching your poor system toward its ceiling, check out these options.

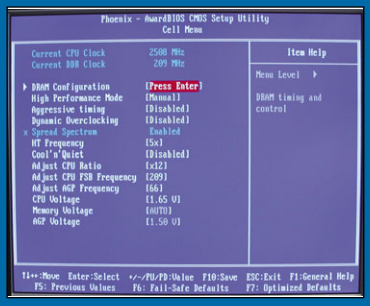
Performance Comparison

MSI K8N Neo2 Platinum Edition

Benchmark	AMD Athlon 64 3500+	AMD Athlon 64 3800+	AMD Athlon 64 FX-53	AMD Athlon 64 FX-53 2.4GHz at 2.58GHz, 1.65V
3DMark03 Build 340	5235	5280	5286	5328
PCMark04 1.2.0	4324	4675	4697	4997
CPU	4158	4456	4517	4830
Memory	4604	4750	4858	5189
Graphics	4552	4564	4590	4614
HDD	4525	4569	4560	4616
Halo				
800 x 600	49.02fps	50.83fps	51.9fps	53.7fps
1,024 x 768	44.76fps	45.72fps	46.04fps	46.84fps
1,280 x 1,024	31.49fps	31.55fps	31.49fps	31.79fps
Doom 3				
800 x 600	24.9fps	24.3fps	25.1fps	25.2fps
1,024 x 768	17.8fps	17.8fps	17.8fps	17.9fps
1,280 x 1,024	12fps	12.1fps	12fps	12.2fps



The K8N Neo2 Platinum Edition's Phoenix BIOS has a password feature that lets you lock out other users.



The Cell Menu has plenty of overclocking tools. The Item Help section offers (very) brief descriptions of each field.

The first automatic OC option is Aggressive Timing, which automatically tightens your memory's timings. The second feature, Dynamic Overclocking, controls the FSB. You can choose from six levels that raise the CPU frequency by a certain percentage, including Private (1%), Sergeant (3%), Captain (5%), Colonel (7%), General (9%), and Commander (11%). No matter which level you choose, Dynamic Overclocking only raises the frequency when your system takes on heavy loads. Keep in mind that this system isn't necessarily any safer than the BIOS' standard settings: You may feel like a general, but your system may not.

Users who want to overclock via traditional methods will find that the board offers solid setting ranges: The AGP Frequency ranges from 66 to 100MHz, the CPU FSB Frequency ranges from 200 to 300MHz, and the multiplier range starts at x4 and supports up to x20.

Thanks to the Winbond I/O chip, the BIOS' H/W Monitor section includes Smart CPU Fan, a feature that adjusts the CPU fan's speed to match a specific target temperature range.

Performance

We didn't run into any trouble when we ran the benchmarks at stock settings. The MSI K8N Neo2 didn't quite break even with its nForce3 competitor, the GIGABYTE GA-K8NSNXP-939, but all of its 3DMark03 scores landed within four points of the GIGABYTE board's scores. The two boards also posted similar PCMark04 scores at stock settings, but the GA-K8NSNXP-939 occasionally pulled ahead by a fraction of an fps when we ran the Doom 3 and Halo. At stock settings, these boards are nearly identical.

Next, we overclocked each of our three processors and ran all of the benchmarks again. This time, the K8N Neo 2 took a slight lead: the board's scores consistently rose a few points higher than its counterpart's. However, both boards posted similar scores in the game benchmarks.

Oddly enough, neither board liked voltages above 1.5V when we overclocked the Athlon 64 3800+, but the K8N Neo 2 handled 1.65V without any trouble when we overclocked the Athlon 64 3500+ and the Athlon 64 FX-53. The higher voltages let us push the board CPU clock speeds higher when we overclocked the MSI board: The FX-53/K8N Neo2 maxed out at 2.58GHz, the 3800+/K8N Neo2 maxed out at 2.5GHz, and the 3500+/K8N Neo2 didn't cry out for mercy until we broke 2.31GHz.

System Specs	
Component	Model
Motherboard	MSI K8N Neo2 Platinum Edition
Processor	AMD Athlon 64 3500+
Processor	AMD Athlon 64 3800+
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

Final Word

Although the K8N Neo2 Platinum Edition probably won't provide better benchmark scores or frame rates than GIGABYTE's nForce3 offering, it certainly wins the price war: The K8N Neo2 sells for about $135. GIGABYTE generally offers high-priced boards, but we often find that they have more features. In this case, the K8N Neo2 draws even: It's just as overclockable and provides strong scores. If you prefer one of these two brands, you won't regret staying loyal. CPU

Overall Rating:

by Joshua Gulick

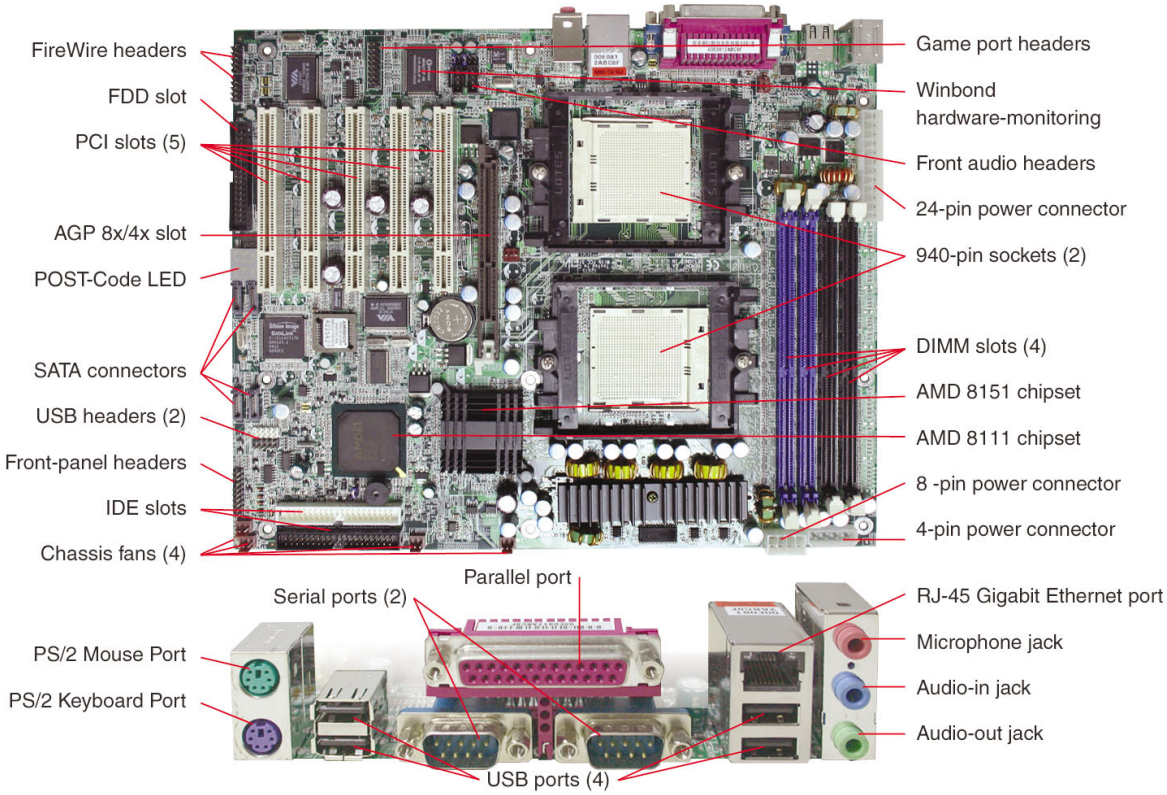
MSI K8N Neo2 Platinum Edition	
Socket Type	Socket 939 AMD
Chipset	NVIDIA nForce3 Ultra
Processor Support	Athlon 64, Athlon 64 FX
RAM Support	4GB DDR400/333/266
RAM Slots	4
Graphics Bus	AGP 8X
PCI Slots	5
SATA Ports	4 (RAID 0, 1, 0+1)
IDE	2 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	2 internal
LAN	Marvell 88E1111-RCJ Gigabit; Realtek RTL8110S-32 Gigabit
Integrated Audio	8-channel, SPDIF
Integrated Graphics	N/A
Other Features	DigiCellDOTLive UpdatePC Alert
Manufacturer	MSI
Phone	(626) 913-0828
URL	www.msicomputer.com
Price	$135

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Tyan Tiger K8W S2875

Layout: ATX (Socket 940)

Chipset: AMD-8111



Dual-processor motherboards are in many ways completely different creatures from their single-processor counterparts. Most dual-Opteron systems are designed for servers rather than home PCs. However, Tyan's Tiger K8W S2875 is one of a handful of motherboards that fits into a standard ATX case.

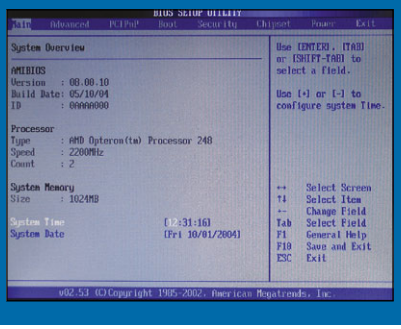
Anatomy Of The Tiger

The Tiger K8W makes great use of the space provided by the ATX form factor. When Tyan squished two 940-pin sockets and a set of server features into a desktop-sized ATX board, it had to make some trade-offs to manage an ATX design and maintain an affordable price.

One of the things we didn't like about the Tiger K8W's layout was how close the CPU sockets are to each other and to the surrounding capacitors. This made heatsink installation awkward, and many third-party heatsinks wouldn't even fit. Heatsinks may also get in the way of some AGP cards. Although we don't like how cramped the CPUs are, the arrangement was probably necessary to accommodate the ATX format.

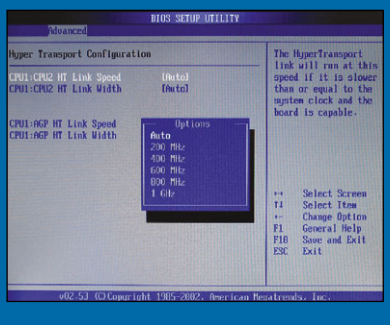
Tyan's board has no northbridge, instead relying on each Opteron's integrated memory controller. These dual-channel controllers provide great promise, enabling 128-bit support to each processor. Also, Opterons can each access a separate memory bank for 256-bit-effective memory support. However, Tyan's motherboard has a shared memory bus, so only one CPU has a direct path to the memory. The second Opteron must send requests through the first processor, limiting the potential of the dual-Opteron configuration.

The board's chipset includes an AMD-8111 HyperTransport I/O hub and an AMD-8151 HyperTransport AGP3.0 graphics tunnel. One drawback of the AMD-8111 chip is that it only supports Full-Speed USB. Tyan soldered a VIA USB 2.0 controller onto the board



Here you can see the straightforward, easy-to-navigate menu for the Tyan Tiger K8W's AMI BIOS Setup Utility.

Some users will shy away from the Tiger K8W because it is not overclockable.



for Hi-Speed USB support for half of the USB ports. Tyan also includes a VIA FireWire controller, but we were dismayed to discover that there are no FireWire ports and no bundled expansion card.

Additional chips include a Gigabit Ethernet controller and a Silicon Image SATALink 3114 controller for the board's four SATA ports. Tyan bundles four SATA data/power cables. The Tiger K8W supports RAID 0, 1, and 0+1.

Get Connected

The Tiger K8W offers a fairly complete range of ports and slots. The motherboard houses five PCI slots, an AGP8X/4X slot, four SATA ports, two IDE slots, and four DIMM slots, which support up to 8GB of registered DDR. The board's I/O ports include four USB ports, two Full-Speed and two Hi-Speed. Additional USB headers on the motherboard let you add one Full-Speed and one Hi-Speed USB port through either an expansion card or a case's front USB port.

The I/O plane houses two serial ports, a parallel port, and three standard audio ports. The Tiger K8W supports six-channel audio through its Realtek AC'97 chip.

One of the outstanding features of this board is its adaptability with regards to the power supply. It not only works with an EPS12V power supply, which is typical for most dual-Opteron motherboards but also with a standard ATX power supply. To use the ATX power supply, you must plug the 20-pin ATX connector into the designated portion of the 24-pin socket on the motherboard. The ATX 4-pin connector plugs into half of the 8-pin EPS12V socket. Finally, one of the 4-pin drive power connectors plugs into the space next to the 8-pin EPS12V socket.

The Tiger K8W also has six case-fan connectors, three with tachometer support. One of the handiest features, though, is the Tiger K8W's POST Code LED. This display on the motherboard shows codes at various phases of the boot process. If your system won't POST, you can tell from the POST Code LED where in the process the failure occurs. A POST code guide is available at the AMI site (www.ami.com).

BIOS Features

To update the Tiger K8W, you use AMI FLASH. This requires a Windows 9x bootable floppy diskette. Once you download the BIOS files to a separate diskette, boot from the bootable disk, insert the disk with the downloaded files, and type **flash** at the A: prompt. The flash utility does the rest automatically.

The BIOS supports DMI2.0 network management and several power management specifications (APM 1.2, ACPI 1.0, WfM2.0, S1, S4, and S5). The setup menu is simple to navigate. There is only one area in which the BIOS is lacking. The Tiger K8W is not overclockable. You can only adjust the system bus in 200MHz intervals. Because of the limited overclocking options in the BIOS Setup Utility, we only benchmarked the K8W at its default settings. Al-though dual-Opter-on systems aren't known for tremendous overclocks, if you'd like to see how far we could push an overclockable dual-Opteron system, see the next review, "MSI K8T Master2-FAR" on p. 115.

How We Tested

We built our test system in an Antec Performance Plus1080AMG case with a 550W Antec TruePower ATX power supply. We could not use the same PC4400 DDR that we used in our other motherboard testing systems, because Opteron CPUs require registered memory. Instead, we used a 1GB matched-pair kit of OCZ's EL PC3200 ECC Registered DDR.

To round out our system, we installed an 80GB Maxtor 7,200rpm SATA drive with 8MB cache and a 128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100 XT AGP video card. We installed Windows XP Home and benchmarked the motherboard

Benchmark	Opteron 242	Opteron 246	Opteron 248
3DMark03 Build 340	4410	4619	4665
PCMark04 1.2.0	3147	3769	4107
CPU	3056	3769	4127
Memory	4147	4931	5222
Graphics	3029	3115	3115
HDD	4351	4377	4362
Halo			
800 x 600	47.72fps	51.36fps	52.31fps
1,024 x 768	41.61fps	42.87fps	41.15fps
1,280 x 1,024	28.82fps	29.19fps	28.46fps
Doom3			
800 x 600	16.1fps	17.1fps	17.3fps
1,024 x 768	13.6fps	14.2fps	14.3fps
1,280 x 1,024	10.5fps	10.9fps	10.7fps

using three pairs of Opteron processors: Models 242, 246, and 248.

We ran the 3DMark03 and PCMark04 benchmarks on each system, as well as timedemos for Halo and Doom 3. For each of the timedemos, we tested at three resolutions.

Dual-Opteron Performance

First, we tested the Tiger K8W with two 1.6GHz Opteron 242s. It is important to note that Opteron 242s and 246s only support memory up to PC2700, so our PC3200 RAM would not run at its full 400MHz potential. We expected to see a hit in the performance when these CPUs were installed due to the memory frequency limitations.

The Tiger K8W achieved a decent 4410 3DMarks and 3147 PCMarks. We did not expect stellar results, simply because FutureMark's benchmarks are not built for dual-processor systems. A further breakdown of the PCMark tests shows which areas slowed down the Tiger K8W. The highest score, not surprisingly, came in the HDD test (4351), which probably benefited from our SATA drive. The next highest score was in the Memory test, indicating that the 333MHz memory frequency might not be so problematic for the system. The lowest scores came from the CPU test (3056) and Graphics test (3029).

Halo scores were far more impressive, with a 47.72fps rate at 800 x 600. Increasing the resolution to 1,024 x 768 did not result in much of a hit to the experience of playing Halo with the Tiger K8W.; Tyan's board still managed 41.61fps. Only when we increased the resolution to 1,280 x 1,024 did we see a real drop in performance. Video became slightly jerky, and the frame rate dropped to 28.82fps. Despite our excellent Halo scores, Doom 3's timedemo was a disaster. The Tiger K8W managed just 16.1fps at 800 x 600, 13.6fps at 1,024 x 768, and 10.5fps at 1,280 x 1,024.

Next, we tested the Tiger K8W with a pair of 2GHz Opteron 246s. We saw slightly elevated scores in most areas of our testing. The 3DMark score was 4619, and the PCMark score jumped to 3769, quite an improvement. The Graphics and HDD scores barely moved, but we saw improvement in the CPU and Memory tests (3769 and 4931). Halo results moved to 51.36fps (800 x 600), 42.87fps (1,024 x 768), and 29.19fps (1,280 x 1,024), as did Doom's scores (17.1fps, 14.2fps, and 10.9fps).

We expected the best performance with the 2.2GHz Opteron 248s, with their high clock speeds and PC3200 support. However, the 3DMark score (4665) and PCMark score (4107) barely moved. PCMark's Graphics score was the same, and the HDD score declined (to 4362). The CPU and Memory scores improved to 4127 and 5222,.

At an 800 x 600 resolution, the 248s aided the K8W in achieving 52.31fps in Halo. However, at the higher resolutions, the frame rate dropped to 41.15fps (1,024 x 768) and 28.46fps (1,280 x 1,024). Doom 3's scores were unaffected at 17.3fps, 14.3fps, and 10.7fps.

The right pair of processors can really affect the performance of the Tiger K8W, but more in some areas than in others. We felt that the video card played a major role in the experiences of games such as Halo and Doom 3, and that the choice of processor didn't matter much.

Final Word

The Tiger K8W is an excellent motherboard if you're looking for a starter dual-Opteron board. Not only does it have support for many technologies, it also fits in a standard ATX case and accepts an ATX power supply. If you want to take advantage of the Opterons' advanced capabilities (such as a 256-bit-effective memory bus), you may want to step up to the more expensive, beefed-up version of this board, the EATX Thunder K8W. The Tiger K8W has some weaknesses, such as its shared memory bus. However, given the Tiger K8W's very attractive price, this board is a good value and a great way for a newcomer to try a dual-Opteron system. CPU

Overall Rating: CPU CPU CPU CPU

by Kylee Dickey

Component	Model
Motherboard	Tyan Tiger K8W S2875
Processors, System 1	2 AMD Opteron 242s
Processors, System 2	2 AMD Opteron 246s
Processors, System 3	2 AMD Opteron 248s
Memory	
OCZ PC3200 DDR, 512MB EL DDR ECC Registered, 2-3-2-6	
Video Card	
128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT	
Hard Drive	
80GB Maxtor 6Y080M0 SATA 7,200rpm, 8MB cache	
Optical Drive	
Sony Beige 52X/32X/52X/16X Combo Drive, Model CRX320E (OEM)	
Chassis	Antec Performance Plus 1080AMG
Operating System	Windows XP Home

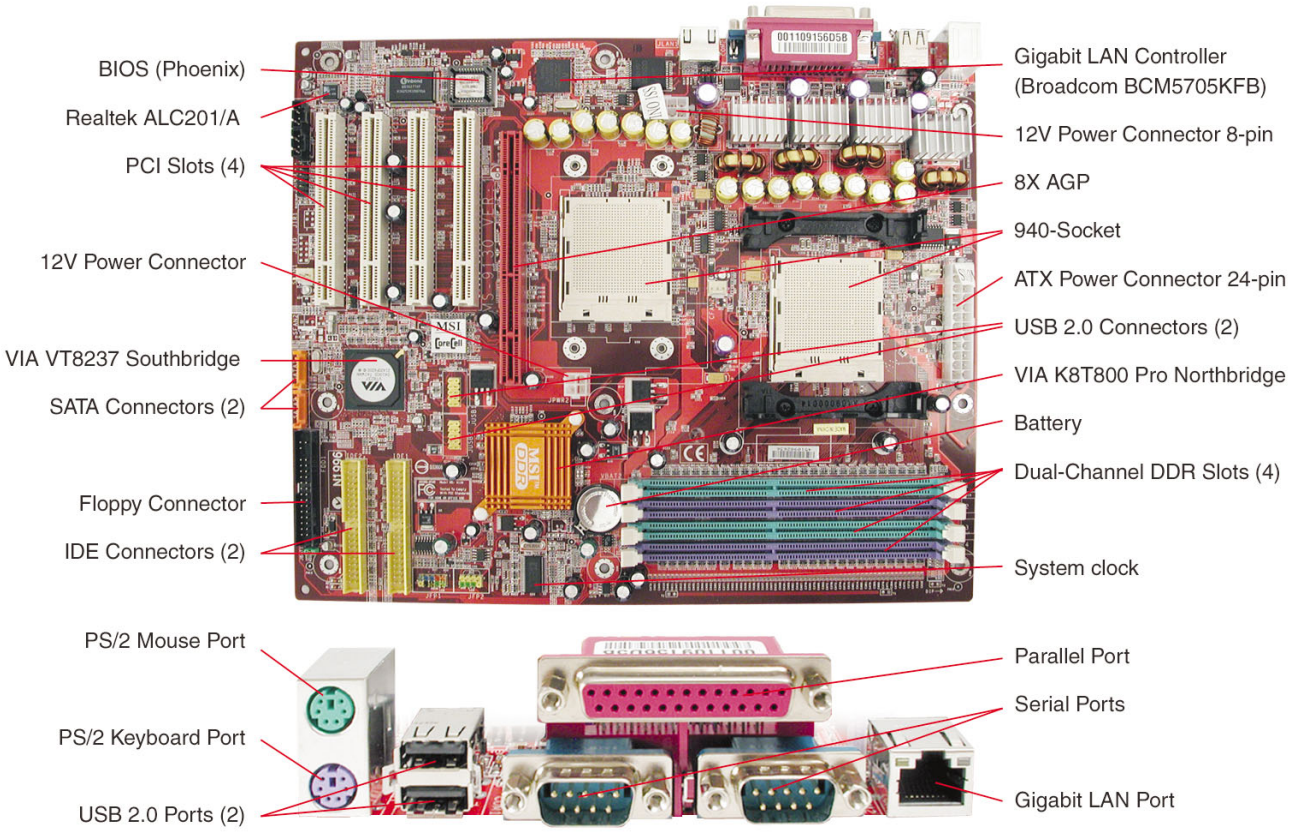
Tiger K8W S2875	
Socket Type	Socket 940 (2)
Chipset	
AMD-8151 HyperTransport AGP3.0 Tunnel, AMD-8111 HyperTransport I/O Hub, Winbond W83627HF Super I/O chip	
Processor Support	
single Athlon 64 FX51, single Opteron 100 series, single Opteron 200 series, and dual Opteron 200 series and up	
RAM Support	
Up to 8GB of PC1600/2100/2700/3200 DDR	
RAM Slots	
four DIMMs (each support 64MB to 2GB of DDR)	
Graphics Bus	AGP 8X/4X
PCI Slots	5
SATA Ports	4
IDE	2
USB Ports	6
(2 stacked Full-Speed ports, 2 stacked Hi-Speed ports, 1 Full-Speed header, 1 Hi-Speed header)	
FireWire Ports	
No ports, 2 IEEE1394a headers	
LAN	
1 RJ45 port with Gigabit support and activity LED	
Integrated Audio	N/A
Integrated Graphics	N/A
Other Features	
POST Code LED, WfM2.0 power management, onboard VRM, W83627HF hardware monitoring, 3 3-pin fan headers with tachometer montoring, 3 3-pin fan headers without tachometer monitoring, and RAID 0, 1, 0+1 support	
Manufacturer	Tyan
Phone	(510) 651-8868, ext.5120
URL	www.tyan.com
Price	$319

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

MSI K8T Master2-FAR

Layout: ATX (Socket 940)

Chipset: VIA K8T800



The MSI K8T Master2-FAR is an ATX dual-Opteron motherboard. Some compromises were necessary to bring a server-worthy configuration to a smaller form factor, but MSI made respectable choices.

VIA Onboard

Where some dual-Opteron boards rely on the Opterons' memory controllers for northbridge support, this one has an integrated VIA K8T800 chipset, making the motherboard compatible with single-processor setups with a Socket 940 Athlon64 FX 51 or a single Opteron.

VIA's northbridge provides an 800MHz HyperTransport bus and AGP Pro/8X/4X/2X support. The K8T800 connects to the VT8237 southbridge through a 1.06GBps interconnect. The VT8237 supports the motherboard's four PCI slots, two SATA ports, two Dual-Channel ATA133/100/66/33 slots, USB ports, integrated audio, and RAID 0 and 1 configurations.

Physical Layout

The Master2-FAR's I/O panel includes a keyboard port, a mouse port, two serial ports, one parallel port, two Hi-Speed USB 2.0 ports, and an RJ-45 Gigabit Ethernet connector. Additional USB connectivity is available through the headers for two front Hi-Speed USB ports.

The board includes four DIMM slots for up to 8GB of registered DDR (up to PC3200). The Master2-FAR has a shared memory bus in which the second CPU accesses memory through the first CPU. This may create a bottleneck but is a fairly common configuration for ATX dual-Opteron systems.

Power connectors include a 24-pin connector, a 4-pin plug, and an 8-pin plug. Stickers cover the holes that should remain empty when using an ATX power supply's

20-pin and 4-pin cables in the 24- and 8-pin connectors. The board has four fan headers and includes an arsenal of cables, but some of the cables were too short, so we had to place our optical drive in the lowest drive bay.

The most interesting element of the Master2-FAR's design is its use of proprietary copper heatsinks, which are designed to fit within the minimal space next to the AGP slot. The first CPU's heatsink is larger and includes a pair of retention clips. The second heatsink is smaller and has four large screws that screw directly into the motherboard. This small, custom heatsink leaves enough room for an AGP card, but the rear cooling fan of some video cards may not fit due to the proximity of the heatsink. The proprietary heatsinks are better than the ones AMD ships with its Opterons, but the downside is that you can't use third-party heatsinks. If you haven't already bought your Opterons, you can buy OEM because you don't need the retail CPUs' heatsinks.

BIOS & Software

The MSI K8T Master2-FAR's BIOS offers more opportunities to tweak your system than Tyan's Tiger K8W's BIOS. For example, you can use the Frequency/Voltage Control submenu to adjust the CPU Clock Ratio (assuming that your processor's multiplier isn't locked), CPU Voltage, and CPU Clock. This provides more overclocking freedom than many dual-Opteron boards do.

BIOS menus are easy to navigate and self-explanatory. The Master2-FAR uses Award BIOS. To flash the BIOS, you need a Windows 98/Me boot disk. MSI's support page can walk you through the rest of the fairly simple procedure. Also, MSI's Live Update is supported and can download and update the appropriate BIOS version automatically.

Among the BIOS features are PCI 2.2, DMI network management, and power management features, including APM 1.2, WOL, and ACPI (S1, S2, S4, and S5). The BIOS also includes temperature, voltage, and fan monitors. The CPU fans in this system sound like a small plane taking off, so we were definitely thrilled that the BIOS includes a temperature-sensitive fan speed option.

The Master2-FAR bundles an intriguing collection of software, including Adobe Photoshop Album 1.0, Fuzzy Logic 4 (an overclocking tool that adjusts the AGP ratio), Restore IT, WinDVD 4, WinRip 2, and VirtualDrive.

K8T Master2-FAR Goes The Distance

We tested the K8T Master2-FAR in an Antec Performance Plus1080AMG case with an Antec TruePower 550W ATX power supply, 1GB of PC3200 DDR (a matched-pair kit of OCZ Registered ECC EL 2-3-2-6 memory), a 128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT video card, and an 80GB Maxtor 7,200rpm SATA drive with 8MB cache. We installed Windows XP Home on our test system and benchmarked the Master2-FAR with three pairs of processors: two Opteron 242s, two Opteron 246s, and two Opteron 248s.

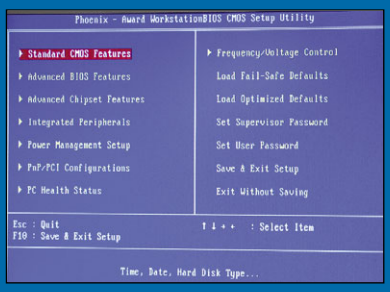
We benchmarked each system with 3DMark03 and PCMark04 first and then ran the Halo and Doom 3 timedemos to see how well the board works in real-life situations. We ran each timedemo at three resolutions: 800 x 600; 1,024 x 768; and 1,280 x 1,024.

We ran the first set of benchmarks with the 1.6GHz Opteron 242s installed. The 242s only support DDR up to PC2700, so we did not expect to get the full benefit of our PC3200 DDR from this configuration. The Master2-FAR's 3DMark score was an impressive 5641. Our PCMark score was lower than expected, only reaching 3442. The Graphics and HDD tests scored fairly well, at 4699 and 4557, respectively. The Memory test was a bit lower at 4179, but the test that really drug down the overall PCMark score was the CPU test (3077). These benchmarks do not measure dual-processor performance, and the shared memory bus can, in some cases, result in lower scores when a second CPU's installed.

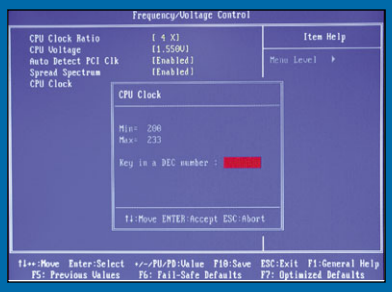
MSI's board fared well in the Halo timedemo, hitting 45.07fps at 800 x 600, 51.61fps at 1,024 x 768, and 36.69fps at 1,280 x 1,024. The frame rates in Doom 3 were much lower, at only 26.6fps (800 x

Component	Model
Motherboard	MSI K8T Master2
Processors, System 1	2 AMD Opteron 242s
Processors, System 2	2 AMD Opteron 246s
Processors, System 3	2 AMD Opteron 248s
Memory	
OCZ PC3200 DDR, 512MB EL DDR ECC Registered, 2 3-2-6	
Video Card	
128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT	
Hard Drive	
80GB Maxtor 6Y080M0 SATA 7,200rpm, 8MB cache	
Optical Drive	
Sony Beige 52X/32X/52X/16X Combo Drive, Model CRX320E (OEM)	
Chassis	
Antec Performance Plus 1080AMG	
Operating System	Windows XP Home

K8T Master2-FAR	
Socket Type	Socket 940 (two)
Chipset	VIA K8T800 northbridge, VIA VT8237 southbridge
Processor Support	
Single Athlon 64 FX51, single Opteron 100 series, single Opteron 200 series, and dual Opteron 200 series and up	
RAM Support	
Up to 8GB of PC1600/2100/2700/3200 DDR	
RAM Slots	
4 DIMMs (each support 64MB to 2GB of DDR)	
Graphics Bus	AGP 8X
PCI Slots	4
SATA Ports	2
IDE	2
USB Ports	
4 (2 rear ports, 2 front headers)	
FireWire Ports	
No ports, IEEE 1394 header	
LAN	
2 ports, Broadcom BCM5705 Gigabit LAN controllers	
Integrated Audio	N/A
Integrated Graphics	N/A
Other Features	
Live Update, Fuzzy Logic, PC Alert, 800MHz HyperTransport, Ultra V-Link 1.06GBps northbridge/southbridge link, RAID 0, 1; ATA 33/66/100/133; ACPI/OnNow; 2 system fan headers; 2 serial ports; 1 parallel port; WOL; PC Health Monitoring (for temperature, voltage, and fans)	
Manufacturer	MSI
Phone	(626) 913-0828
URL	www.msicomputer.com
Price	$214



The MSI K8T Master2-FAR's BIOS Setup Utility is easy to navigate and provides more options than the BIOSes of many similar dual-Opteron motherboards.



The K8T Master2-FAR's BIOS offers a few overclocking options, which are a rare commodity in the dual-Opteron market.

600), 19.8fps (1,024 x 768), and 13.6fps (1,280 x 1,024).

After installing the 2GHz Opteron 246s, we ran the benchmarks and timedemos again. This time, the 3DMark score rose to 5850, while the PCMark score leapt to 4142. A closer look at the PCMark scores reveals that the Graphics and HDD scores are mostly independent of the installed processor. The Graphics score only rose to 4842, and the HDD score barely moved, hitting 4583. The real improvements, then, came in the CPU score (3798) and the memory score (4927).

The Opteron 246s helped the Master2-FAR climb to Halo frame rates of 60.2fps (800 x 600) and 54.44fps (1,024 x 768), and 36.99 fps at 1,280 x 1,024. In the Doom 3 timedemo, the Master2-FAR with Opteron 246s installed performed almost the same as it did with the 242s installed. Its frame rates were 27.1fps (800 x 600), 20.1fps (1,024 x 768), and 13.7fps (1,280 x 1,024).

Based on the results of our previous benchmarks, we expected to see minimal improvements in the Master2-FAR's performance with the Opteron 248s installed. The 3DMark03 score rose to 5908. The overall PCMark04 score (4524) improved, although not as drastically as when we swapped the 242s with 246s. The CPU test returned a score of 4117 (up over 300 points), and the Memory test returned a score of 5240 (also up over 300 points). The Graphics score (4914) rose slightly, and the HDD score fell 20 points to 4563.

Installing the faster Opteron 248s had barely any effect on Halo performance with the frame rate set at 1,024 x 768 (54.94fps) or 1,280 x 1,024 (36.94fps). However, there was some improvement at the lowest resolution of 800 x 600 (63.11fps). As expected, the frame rate really didn't improve for the Doom 3 timedemo. At 800 x 600, the frame rate rose only 0.2fps, to 27.3fps. At each of the two higher resolutions, the frame rate only improved by 0.1fps, to 20.2fps (1,024 x 768) and 13.8fps (1,280 x 1,024).

Although the Master2-FAR provides overclocking options in the BIOS, we didn't expect to push the performance of this board very far, simply because Opterons are not known for producing great overclocks. We overclocked the system with each of the three pairs of Opterons installed. In each case, we could only raise the bus speed to 202MHz before the system became unstable. Each of the three successful overclocks resulted in minimal improvement in the benchmarks.

Master Of The Opterons

MSI's K8T Master2-FAR isn't the most powerful or feature-rich dual-Opteron system you'll find. However, its benchmark scores ran circles around the Tyan Tiger K8W's (see "Tyan Tiger K8W" on p. 112). The Master2-FAR is one of the fastest and most affordable ATX dual-Opteron boards available. If you want a high-performing, affordable dual-Opteron board, it doesn't get better than the Master2-FAR. CPU

Overall Rating: CPU CPU CPU CPU

by Kylee Dickey

Benchmark	Opteron 242	Opteron 242 Overclock (at 202MHz bus speed)	Opteron 246 Overclock (at 202MHz bus speed)	Opteron 246	Opteron 248	Opteron Overclock (at 202MHz bus speed)
3DMark03 Build 340	**5641**	**5663**	**5850**	**5850**	**5908**	**5909**
PCMark04 1.2.0	**3442**	**3448**	**4142**	**4185**	**4524**	**4563**
CPU	3077	3096	3798	3807	4117	4215
Memory	4179	4233	4927	4994	5240	5298
Graphics	4699	4706	4842	4848	4914	4936
HDD	4557	4567	4583	4665	4563	4557
Halo						
800 x 600	54.07fps	54.59fps	60.2fps	61.91fps	63.11fps	64.76fps
1,024 x 768	51.61fps	51.82fps	54.44fps	54.54fps	54.94fps	55.24fps
1,280 x 1,024	36.69fps	36.73fps	36.99fps	37.03fps	36.94fps	37.17fps
Doom 3						
800 x 600	26.6fps	26.6fps	27.1fps	27.1fps	27.3fps	27.3fps
1,024 x 768	19.8fps	19.9fps	20.1fps	20.1fps	20.2fps	20.2fps
1,280 x 1,024	13.6fps	13.6fps	13.7fps	13.7fps	13.8fps	13.8fps

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

Intel Mobo Bench Summary

Compare A Few Key Stats From Our Reviews Of Intel-Compatible Boards

Socket 478

		Celeron D 335 2.8GHz		Pentium 4 2.4GHz		Pentium 4 2.8GHz		Pentium 4 3.2E GHz		P4 Extreme Edition 3.4GHz	
		Stock	Overclock	Stock	Overclock	Stock	Overclock	Stock	Overclock	Stock	Overclock
Abit VT7	3DMark03 b.340			5186	5316			5569	5608	5583	5664
Socket 478	PCMark04 1.2.0			3806	4068			4891	5157	5207	5588
VIA PT880	Doom 3 (1,024 x 768)			22.1	26.8			26.6	27.3	27.2	27.3
	CPU Clock Speed			2.4GHz	2.56GHz			3.2GHz	3.39GHz	3.4GHz	3.62GHz
SOYO SY-P4VTP	3DMark03 b.340			4505	No OC	4456	N/A	4595	No OC	4661	N/A
VIA PT800	PCMark04 1.2.0			3048	No OC	3529	N/A	4293	No OC	4333	N/A
	Doom 3 (1,024 x 768)			21.1	No OC	21.5	N/A	21.9	No OC	21.4	N/A
	CPU Clock Speed			2.4GHz	No OC	2.8GHz	N/A	3.2GHz	No OC	3.4GHz	N/A
ASUS P4S800D-E	3DMark03 b.340			4723	4444	4745	4475	4789	4507		
SiS 655TX	PCMark04 1.2.0			3618	4157	4069	4287	4642	4834		
	Doom 3 (1,024 x 768)			21.4	25.4	21.1	21.5	21.9	22		
	CPU Clock Speed			2.4GHz	3.12GHz	2.8GHz	3.28GHz	3.2GHz	3.34GHz		
GIGABYTE	3DMark03 b.340	5878	6071					6232	6294	6299	6324
GA-8IG	PCMark04 1.2.0	3636	4085					4820	4901	5234	5512
1000 Pro-G	Doom 3 (1,024 x 768)	19.4	19.9					20.1	20.2	20.1	20.1
Intel i865G	CPU Clock Speed	2.8GHz	3.57GHz					3.2GHz	3.52GHz	3.4GHz	3.62GHz
ASUS P4R800-V	3DMark03 b.340	5639	5722					5877	5961	5948	6010
Deluxe	PCMark04 1.2.0	3643	3950					4776	5230	5174	5563
ATI ADEON 9100 IGP	Doom 3 (1,024 x 768)	20.1	20.5					21	21.1	21	21.1
	CPU Clock Speed	2.8GHz	3.08GHz					3.2GHz	3.52GHz	3.4GHz	3.69GHz
Chaintech S865PE	3DMark03 b.340	5966	6167					6276	6289	6347	6402
Intel 865PE	PCMark04 1.2.0	3815	5589					4996	5055	5402	5589
	Doom 3 (1,024 x 768)	19.7	20.1					20.1	20.1	20.1	20.1
	CPU Clock Speed	2.8GHz	3.21GHz					3.2GHz	3.57GHz	3.4GHz	3.57GHz
Chaintech 9CJS	3DMark03 b.340	5961	6236					6282	6325	6366	6433
Zenith	PCMark04 1.2.0	3827	4568					5070	5236	5465	5829
Intel 875P	Doom 3 (1,024 x 768)	19.7	20					20.1	20.2	20.1	20.2
	CPU Clock Speed	2.8GHz	3.36GHz					3.2GHz	3.36GHz	3.4GHz	3.63GHz

LGA 775

		Pentium 4 520 2.8GHz		Pentium 4 540 3.2GHz		P4 Extreme Edition 3.4GHz	
		Stock	Overclock	Stock	Overclock	Stock	Overclock
GIGABYTE GA-8I915G	3DMark03 b.340	4853	4988	4926	5000	4955	4980
Pro	PCMark04 1.2.0	3643	4349	3958	4549	4139	4336
Intel 915G	Doom 3 (1,024 x 768)	20.1	20.4	20.3	20.4	20.3	20.3
	CPU Clock Speed	2.8GHz	3.52GHz	3.2GHz	3.76GHz	3.4GHz	3.57GHz
MSI 915G Combo-FR	3DMark03 b.340	4879	4949	4947	4998	4962	5011
Intel 915G	PCMark04 1.2.0	4198	4580	4745	4154	5003	5725
	Doom 3 (1,024 x 768)	20.2	20.4	20.4	20.5	20.4	20.5
	CPU Clock Speed	2.8GHz	3.05GHz	3.2GHz	3.76GHz	3.4GHz	3.57GHz
Intel D915PCYL	3DMark03 b.340	4864	No OC	4938	No OC	4974	No OC
Intel 915P	PCMark04 1.2.0	4201	No OC	4713	No OC	5025	No OC
	Doom 3 (1,024 x 768)	20.3	No OC	20.4	No OC	20.4	No OC
	CPU Clock Speed	2.8GHz	No OC	3.2GHz	No OC	3.4GHz	No OC
ASUS P5GD2 Deluxe	3DMark03 b.340	5131	5205	5161	5191	5212	5209
Intel 915P	PCMark04 1.2.0	4213	4964	4703	5220	4981	5092
	Doom 3 (1,024 x 768)	21.4	21.6	21.6	21.7	21.6	21.6
	CPU Clock Speed	2.8GHz	3.46GHz	3.2GHz	3.68GHz	3.4GHz	3.56GHz

AMD Mobo Bench Summary

Compare A Few Key Stats From Our Reviews Of AMD-Compatible Boards

Socket A

		Athlon XP 2400+ 2.00GHz		Athlon XP 2800+ 2.08GHz		Athlon XP 3200+ 2.20GHz	
		Stock	Overclock	Stock	Overclock	Stock	Overclock
ABIT NF7-S (Version 2.0) NVIDIA nForce2 Ultra 400, MCP-T	3DMark03 b.340	4775	4935	4905	5014	5002	5061
	PCMark04 1.2.0	3323	3791	3630	3972	3922	4150
	Doom 3 (1,024 x 768)	21.1	22.4	22.4	22.7	22.6	22.8
	CPU Clock Speed	2GHz	2.25GHz	2.08GHz	2.25GHz	2.2GHz	2.376GHz
ASUS A7V880 VIA KT880, VT8237	3DMark03 b.340	4174	4342	4342	4497	4502	4643
	PCMark04 1.2.0	3087	3455	3342	3722	3622	3966
	Doom 3 (1,024 x 768)	20.7	21.2	21.3	21.6	21.7	22
	CPU Clock Speed	2GHz	2.22GHz	2.08GHz	2.325GHz	2.2GHz	2.42GHz
DFI NFII Ultra Infinity NVIDIA nForce2 Ultra 400, MCP-T	3DMark03 b.340	4870	5064	5044	5161	5160	5251
	PCMark04 1.2.0	3357	3925	3685	4021	3968	4237
	Doom 3 (1,024 x 768)	17.3	17.5	17.4	17.2	17.6	17.7
	CPU Clock Speed	2GHz	2.358GHz	2.08GHz	2.313GHz	2.2GHz	2.387GHz
SOYO SY-KT600 Dragon Ultra Platinum VIA KT600, VT8237	3DMark03 b.340	4668	4743	4801	No Post	Not Stable	Not Stable
	PCMark04 1.2.0	3224	3543	3475	No Post	Not Stable	Not Stable
	Doom 3 (1,024 x 768)	16.3	17.1	16.6	No Post	Not Stable	Not Stable
	CPU Clock Speed	2GHz	2.25GHz	2.08GHz	No Post	Not Stable	Not Stable

Socket 754

		Athlon 64 3200+ 2.00GHz		Athlon 64 3400+ 2.4GHz		Athlon 64 3700+ 2.4GHz	
		Stock	Overclock	Stock	Overclock	Stock	Overclock
ECS 755-A2 SIS 755&964	3DMark03 b.340	5832	5827	5903	5915	5931	5939
	PCMark04 1.2.0	3964	4031	4632	4671	4663	4718
	Doom 3 (1,024 x 768)	19.7	20.1	20.2	20.2	20.2	20.2
	CPU Clock Speed	2GHz	2.02GHz	2.4GHz	2.42GHz	2.4GHz	2.42GHz
AOpen AK89 Max NVIDIA nForce3 150	3DMark03 b.340	5800	5915	5892	5940	5904	5961
	PCMark04 1.2.0	3959	4524	4579	4842	4610	4878
	Doom 3 (1,024 x 768)	20.1	20.3	19.8	20.3	20.3	20.4
		2GHz	2.28GHz	2.4GHz	2.54GHz	2.4GHz	2.53GHz
GIGABYTE GA-K8VNXP VIA K8T800/8237	3DMark03 b.340	5801	5880	5822	5872	5872	5908
	PCMark04 1.2.0	3989	4359	4521	4675	4580	4755
	Doom 3 (1,024 x 768)	20.1	20.3	20.2	20.3	20.3	19.9
	CPU Clock Speed	2GHz	2.23GHz	2.4GHz	2.5GHz	2.4GHz	2.54GHz
EPoX 8KDA3+ NVIDIA nForce3 250Gb	3DMark03 b.340	5809	5936	5871	5910	5886	5923
	PCMark04 1.2.0	3964	4617	4541	4750	4559	4773
	Doom 3 (1,024 x 768)	20.1	20.3	20.2	20.3	20.1	20.3
	CPU Clock Speed	2GHz	2.33GHz	2.4GHz	2.53GHz	2.4GHz	2.52GHz
MSI K8T Neo-FIS2R VIA K8T800, VIA VT8237	3DMark03 b.340	5195	5269	5242	5275	5263	5291
	PCMark04 1.2.0	3949	4351	4479	4689	4536	4740
	Doom 3 (1,024 x 768)	17.7	17.8	17.8	17.9	17.8	17.9
	CPU Clock Speed	2GHz	2.2GHz	2.4GHz	2.54GHz	2.4GHz	2.54GHz
Soltek SL-K8AN2E-GR NVIDIA nForce3 250	3DMark03 b.340	5185	5261	5229	5241	5253	5285
	PCMark04 1.2.0	3974	4346	4497	4677	4552	4787
	Doom 3 (1,024 x 768)	17.7	17.5	17.8	17.8	17.8	17.6
	CPU Clock Speed	2GHz	2.2GHz	2.4GHz	2.52GHz	2.4GHz	2.54GHz

AMD Mobo Bench Summary (Continued)

Socket 940

		Athlon 64 FX-51 2.2GHz (940 pin)		Athlon 64 FX-53 2.4GHz (940 pin)	
		Stock	Overclock	Stock	Overclock
ASUS SK8N NVIDIA nForce3 Pro-150	3DMark03 b.340	5166	N/A	5190	N/A
	PCMark04 1.2.0	4222	N/A	4515	N/A
	Doom 3 (1,024 x 768)	17.2	N/A	17.2	N/A
	CPU Clock Speed	2.2GHz	N/A	2.4GHz	N/A
ASUS SK8V VIA K8T800 Pro, VIA VT8237	3DMark03 b.340	5286	N/A	5327	N/A
	PCMark04 1.2.0	4432	N/A	4770	N/A
	Doom 3 (1,024 x 768)	17.8	N/A	17.9	N/A
	CPU Clock Speed	2.2GHz	N/A	2.4GHz	N/A
GIGABYTE GA-K8NNXP-940 NVIDIA nForce3 150	3DMark03 b.340	5235	N/A	5280	N/A
	PCMark04 1.2.0	N/A	N/A	N/A	N/A
	Doom 3 (1,024 x 768)	17.8	N/A	17.9	N/A
	CPU Clock Speed	2.2GHz	N/A	2.4GHz	N/A
MSI K8T Master2-FAR K8T800 Pro, VT8237	3DMark03 b.340	5296	N/A	5335	N/A
	PCMark04 1.2.0	4481	N/A	4760	N/A
	Doom 3 (1,024 x 768)	17.8	N/A	17.9	N/A
	CPU Clock Speed	2.2GHz	N/A	2.4GHz	N/A

Socket 939

		Athlon 64 FX-53 2.4GHz (939 pin)		Athlon 64 3500+ 2.2GHz (939 pin)		Athlon 64 3800+ 2.4GHz (939 pin)	
		Stock	Overclock	Stock	Overclock	Stock	Overclock
GIGABYTE GA-K8NSNXP-939 NVIDIA nForce3 Ultra	3DMark03 b.340	5290	5323	5239	5269	5281	5304
	PCMark04 1.2.0	4679	4930	4343	4460	4664	4807
	Doom 3 (1,024 x 768)	17.9	17.9	17.8	17.8	17.8	17.8
	CPU Clock Speed	2.4GHz	2.55GHz	2.2GHz	2.28GHz	2.4GHz	2.48GHz
MSI K8N Neo2 Platinum Edition NVIDIA nForce3 Ultra	3DMark03 b.340	5286	5328	5235	5278	5280	5311
	PCMark04 1.2.0	4697	4997	4324	4512	4675	4825
	Doom 3 (1,024 x 768)	17.8	17.9	17.8	17.8	17.8	17.8
	CPU Clock Speed	2.4GHz	2.58GHz	2.2GHz	2.31GHz	2.4GHz	2.5GHz

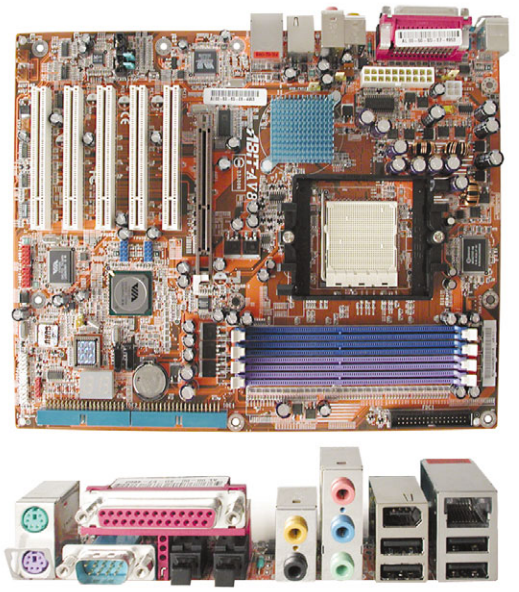
Socket 940 (Dual)

		Opteron 242		Opteron 246		Opteron 248	
		Stock	Overclock	Stock	Overclock	Stock	Overclock
Tyan Tiger K8W S2875 AMD-8111	3DMark03 b.340	4410	N/A	4619	N/A	4665	N/A
	PCMark04 1.2.0	3147	N/A	3769	N/A	4107	N/A
	Doom 3 (1,024 x 768)	13.6	N/A	14.2	N/A	14.3	N/A
	CPU Clock Speed	1.6GHz	N/A	2GHz	N/A	2.2GHz	N/A
MSI K8T Master2-FAR VIA K8T800	3DMark03 b.340	5641	5663	5850	5850	5908	5909
	PCMark04 1.2.0	3442	3448	4142	4185	4524	4563
	Doom 3 (1,024 x 768)	19.8	19.9	20.1	20.1	20.2	20.2
	CPU Clock Speed	1.6GHz	1.62GHz	2GHz	2.02GHz	2.2GHz	2.22GHz

AMD MOBO LEADER

We Throw Five Socket 939 K8T800 Pro Mobos At The Wall To See Which One Sticks

Although both VIA and NVIDIA have produced chipsets that support AMD's new 939-pin Athlon 64s, the NVIDIA nForce3 isn't landing on nearly as many boards as VIA's K8T800 Pro/VT8237, which graces the boards of most big-name mobo makers. We suspect that the upcoming nForce4, which will support the dual-video card SLI technology, will explode onto the Socket 939 scene when it launches. At the moment, the K8T800 Pro has the run of the place, so we grabbed five boards that sport the chipset and put them through their paces.



ABIT AV8-3rd Eye

ABIT AV8-3rd Eye

Although ABIT packages have images that are just as gaudy as other mobo makers' boxes, ABIT takes a modest approach when it designs its boards. If you're lucky enough to get your hands on the new, hard-to-find AV8-3rd Eye, you'll have trouble telling it apart from any other ABIT board; aside from its dark orange PCB, the board is pretty bland. None of the board components jump out at you; the dual-channel DDR 400 memory slots are blue and purple, the northbridge heatsink doesn't have a fan (but a nearby fan connector means you can add one later), and the FireWire (400Mbps) connectors' red bases blend into the board. And lights? Forget it. The board's only light is a small device by the battery that displays two LED characters.

Of course, those two LEDs are much more useful than a board full of bling-bling. The POST-Code Display is one of the best, easiest-to-understand system status features we've seen. We even like this two-character approach more than ASUS' POST Reporter, which offers audible system status descriptions. Although the POST Reporter generally provides great information, it occasionally emits garbled, hard-to-understand messages that leave you without a hint as to why your monitor is staring at you blankly. MSI's POST LED expansion modules also provide status codes, but you'll need to look at the back of your computer to see the codes. Thanks to the AV8-3rd Eye's location, you can simply remove the chassis' side panel and then watch it as the system boots (or tries to). The manual lists dozens of system status codes and explanations.

Unfortunately, ABIT positioned the IDE connectors so that they face off the right side of the board. We prefer standard connectors that face toward the chassis' side panel, as other components might block the connectors. We connected our cables easily enough, but our chassis has a system tray that lets us easily adjust or connect components before sliding the board all the way into the case.

We've seen ABIT's Windows-based µGuru overclocking utility before, but this is the first time we've had a chance to play with its new hardware companion, the Guru Clock. The Guru Clock attaches to your mobo via an internal

Performance Comparison

ABIT AV8-3rd Eye

Benchmark	AMD Athlon 64 3500+	AMD Athlon 64 3800+	AMD Athlon 64 FX-53	AMD Athlon 64 FX-53 2.4GHz at 2.47GHz, 1.65V
3DMark03 Build 340	**5269**	**5315**	**5322**	**5346**
PCMark04 1.2.0	**4374**	**4697**	**4776**	**4856**
CPU	4143	4494	4488	4659
Memory	5265	5451	5558	5706
Graphics	4335	4351	4342	4380
HDD	4469	4464	4552	4502
Halo				
800 x 600	50.78fps	51.64fps	53.05fps	54.04fps
1,024 x 768	46.28fps	44.88fps	47.29fps	46.46fps
1,280 x 1,024	31.97fps	30.95fps	32.07fps	31.6fps
Doom 3				
800 x 600	24.2fps	24.4fps	24.4fps	25.2fps
1,024 x 768	17.8fps	17.9fps	17.9fps	17.9fps
1,280 x 1,024	12.1fps	12fps	12.2fps	12fps

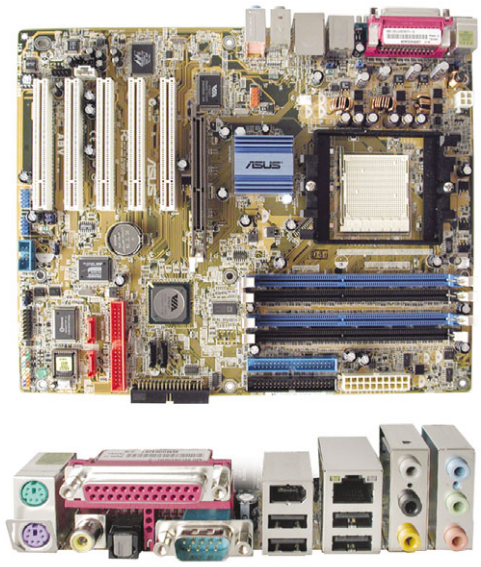
CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

connector and displays much of the system information you'll find in the BIOS. Unlike the BIOS, however, the Guru Clock is active even after Windows loads. The business-card-sized screen displays temperatures, fan speeds, the CPU speeds, the room temp, and the time. The clock also lets you know when you receive MSN email or instant messages.

We also like the Phoenix BIOS' Guru section, which houses all of the overclocking settings, including frequencies and voltages, and the Guru's Power Cycle Statistics section, which lets you know how long your computer has run since its last boot and how many hours it has run since you built the system. The BIOS also has default settings options: Load Fail-Safe Defaults loads the standard settings, but Load Optimized Defaults overclocks the system slightly.

ASUS A8V Deluxe Wireless Edition

ASUS offers two versions of its A8V Deluxe, so keep an eye out for the Wireless Edition if you have an 802.11g network. The board's package includes ASUS' special WiFi@Home PCI card and an antenna that can stand on a desk or shelf. The antenna has a 2.5-foot cord, which means you can move the antenna around to get the best reception. We're glad to see that the new wireless card is compatible with PCI slots; previous versions required a special slot that crowded the bottom PCI slot.



ASUS A8V Deluxe Wireless Edition

The card makes a great accessory, but we like this board with or without the Wi-Fi gear. The A8V Deluxe sports one of Realtek's latest audio codecs, the eight-channel ALC850, a Gigabit LAN controller, and four SATA ports, thanks to a Promise PDC20378 controller. It also has three IDE ports, which means you have additional RAID options if you have any spare IDE hard drives lying around.

We don't like the floppy connector, which faces off the right side of the board. If you have a crowded case, you may have trouble slipping your fingers between the connectors and nearby equipment, such as hard drives, to connect the cable. Our test system's chassis has a removable motherboard tray, so we easily connected the floppy cable before we slid the tray completely into the chassis, but we found that we couldn't remove the cable without first removing the motherboard tray.

Aside from the weird floppy connector, we like the board's clean layout. For example, ASUS didn't put any components near the CMOS header. If you're as impatient as we are, you'll appreciate being able to reach into your system quickly to recover from a failed OC and get back to the BIOS. We were surprised to see that ASUS put the lone internal FireWire (400Mbps) connector on the left side of the board, behind the mass of audio ports, but you can easily string a cable from your chassis' front panel to the connector without causing trouble. Also, the board's FireWire expansion module, which connects to one of the PCI bays (but not the PCI connector), can easily reach the FireWire port.

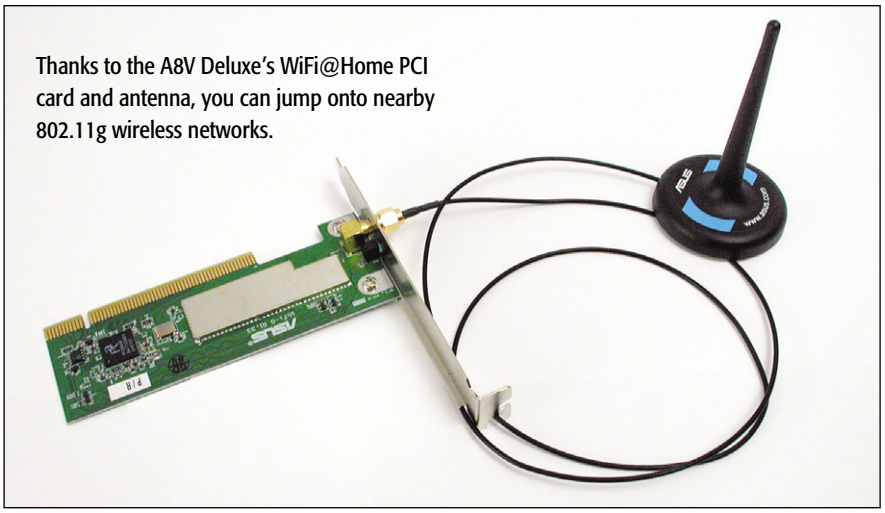
As usual, ASUS tossed a modest but worthy extras package into the box. The package includes several SATA cables with dust caps, a SATA power connector adapter that supports two hard drives, and a USB expansion module that houses two USB 2.0 ports, and a game port that connects to the board's internal game port connector. The package also includes a solid manual and a small cheat sheet that labels important components. ASUS didn't throw a SATA driver floppy into the mix, but it did add a CD that includes the WiFi@Home software that controls your card.

We don't have any complaints about the A8V Deluxe's BIOS. The BIOS controls the POST Reporter, which is one of the better system status features we've seen (well, in this case, heard). The POST Reporter provides audible system status reports during POST. If

Performance Comparison				
ASUS A8V Deluxe				
Benchmark	**AMD Athlon 64 3500+**	**AMD Athlon 64 3800+**	**AMD Athlon 64 FX-53**	**AMD Athlon 64 FX-53 2.4GHz at 2.52GHz, 1.675V**
3DMark03 Build 340	**5239**	**5280**	**5303**	**5318**
PCMark04 1.2.0	**4294**	**4619**	**4653**	**4876**
CPU	4106	4442	4476	4677
Memory	4628	4762	4838	5074
Graphics	4330	4345	4343	4394
HDD	4494	4447	4518	4436
Halo				
800 x 600	49.23fps	51.03fps	52.21fps	53.42fps
1,024 x 768	45.1fps	44.57fps	46.35fps	47.35fps
1,280 x 1,024	31.56fps	30.85fps	31.69fps	32.06fps
Doom 3				
800 x 600	24.2fps	25.1fps	24.4fps	29fps
1,024 x 768	17.8fps	17.8fps	17.9fps	20.6fps
1,280 x 1,024	12.1fps	12fps	12.1fps	13.5fps

your system runs into trouble, you can troubleshoot by listening to the Reporter's messages.

The BIOS also has a neat recovery tool: CrashFree BIOS 2. We're not sure how ASUS came up with that name, as the feature doesn't protect against crashes at all—in fact, you won't use it unless you corrupt the BIOS. CrashFree BIOS 2 lets you use the board's driver CD to refresh a damaged BIOS.



Thanks to the A8V Deluxe's WiFi@Home PCI card and antenna, you can jump onto nearby 802.11g wireless networks.

ECS KV2 Extreme

ECS is known for its streamlined, inexpensive motherboards, so we were a little surprised when we pulled the KV2 Extreme out of its elaborate packaging. From its purple PCB to the orange CPU socket retention frame, the board oozes personality, but it's not all show; the mobo has four SATA ports, three IDE ports, and two Ethernet ports, including a Gigabit LAN port. That's right; it's the only board in our roundup that boasts dual LAN ports.

We're not sure what to make of the 2-inch-wide Extreme tag near the bottom-right corner of the board—we don't like to see wasted space on these already crowded motherboards. That said, it looks like ECS didn't make any sacrifices, space-wise. A row of capacitors crowd the CPU socket retention frame but don't block either of the ends that have hooks, so we installed our heatsink without any trouble. The memory slots also have plenty of room. We're glad to see that ECS colored two of the memory slots yellow and two of them purple; the separate colors help new users quickly identify dual-channel pairs.

The board has two internal FireWire connectors and two USB 2.0 connectors, which means that you can connect your case's front panel connectors. The northbridge has an aluminum heatsink and an LED fan that draws power from a nearby fan connector. Unfortunately, ECD put the 12V connector to the left of the CPU socket, which means you'll need to snake the cable around the CPU and a bunch of capacitors, but none of the other component locations present any problems.

At $135, the KV2 Extreme sits in the middle of this roundup's price range, so the six-channel Realtek ALC655 seems

	ABIT AV8-3rd Eye	ASUS A8V Deluxe	ECS KV2 Extreme	MSI K8T NEO2-FIR	Soltek SL-K8TPro-939
Socket Type	Socket 939 AMD	Socket 939 AMD	Socket 939 AMD	Socket 939 AMD	Socket 939 AMD
Chipset	VIA K8T800 Pro, VT8237	VIA K8T800 Pro, VT8237	VIA K8T800 Pro, VT8237	VIA K8T800 Pro, VT8237	VIA K8T800 Pro, VT8237
Processor Support	Athlon 64, Athlon 64 FX	Athlon 64, Athlon 64 FX	Athlon 64, Athlon 64 FX	Athlon 64, Athlon 64 FX	Athlon 64, Athlon 64 FX
RAM Support	4GB DDR400/333/266	4GB DDR400/333/266	4GB DDR400/333/266	4GB DDR400/333/266	4GB DDR400/333/266
RAM Slots	4	4	4	4	4
Graphics Bus	AGP 8X	AGP 8X	AGP 8X	AGP 8X	AGP 8X
PCI Slots	5	5	5	5	5
SATA Ports	2 (RAID 0,1)	4 (RAID 0,1)	4 (RAID 0,1)	4 (RAID 0,1)	4 (RAID 0,1)
IDE	2 ATA 133	3 ATA 133	3 ATA 133 (RAID 0,1)	3 ATA 133 (RAID 0,1)	4 ATA 133
USB Ports	8; 4 external, 2 internal that support 2 each (2.0)	8; 4 external, 2 internal that support 2 each (2.0)	8; 4 external, 2 internal that support 2 each (2.0)	8; 4 external, 2 internal that support 2 each (2.0)	8; 4 external, 2 internal that support 2 each (2.0)
FireWire Ports	2 internal, 1 external	1 internal, 1 external	2 internal	2 external, 1 internal	1 external, 1 internal
LAN	VIA VT6122 Gigabit	Marvell 88E8001 Gigabit	"Marvell 88E8001 Gigabit; VIA VT6103L 10/100"	Realtek RTL8110S-32 Gigabit	VIA VT6122 Gigabit
Integrated Audio	6-channel, SPDIF	8-channel, SPDIF	6-channel, SPDIF	8-channel, SPDIF	8-channel, SPDIF
Integrated Graphics	N/A	N/A	N/A	N/A	N/A
Other Features	"µGuruFan EqSoftMenu"	"Instant MusicEZ FlashMyLogo2WiFi @Home card Post Reporter"	"Dr. LEDTop-Hat FlashAGP AI"	DigiCell	"Debug LEDSoltek H/M Monitor"
Manufacturer	ABIT	ASUS	ECS (Elitegroup)	MSI	Soltek
Phone	(510) 623-0500	(502) 995-0883	(510) 226-7333	(626) 913-0828	N/A
URL	www.abit-usa.com	usa.asus.com	www.ecsusa.com	www.msicomputer.com	www.soltek.com.tw
Price	$189	$152	$135	$125	$100

Performance Comparison				
ECS KV2 Extreme				
Benchmark	**AMD Athlon 64 3500+**	**AMD Athlon 64 3800+**	**AMD Athlon 64 FX-53**	**AMD Athlon 64 FX-53 2.4GHz at 2.52GHz, 1.675V**
3DMark03 Build 340	**5268**	**5303**	**5310**	**5342**
PCMark04 1.2.0	**4359**	**4699**	**4707**	**4971**
CPU	4117	4461	4474	4732
Memory	N/A	N/A	N/A	N/A
Graphics	4250	4265	4264	4344
HDD	4478	4496	4470	4489
Halo				
800 x 600	49.5fps	52.55fps	52.07fps	53.55fps
1,024 x 768	44.97fps	46.71fps	45.65fps	44.82fps
1,280 x 1,024	31.32fps	31.84fps	31.28fps	30.92fps
Doom 3				
800 x 600	24.9fps	24.3fps	24.4fps	25.2fps
1,024 x 768	17.8fps	17.9fps	17.9fps	17.9fps
1,280 x 1,024	12fps	12.2fps	12.2fps	12fps

out of place; even the $100 Soltek SL-K8TPro-939 has the newer ALC850 chip. Keep in mind, however, that the KV2 Extreme has two Ethernet ports to the SL-K8TPro-939's one.

The KV2 Extreme has a great extras package that includes rounded cables, a USB/FireWire expansion module, and a nifty BIOS-flash device. We like the expansion module, which extends the ports to either the front or back of the chassis, thanks to a plastic attachment that slides into your system's 3.5-inch bay. If your case doesn't already have front-panel connectors, you'll love this simple but worthwhile feature.

Overclockers and anyone else who has damaged a BIOS will appreciate ECS' Top-Hat flash device, which lets you replace a damaged BIOS by attaching a special BIOS chip to the old BIOS chip. Of course, the package also includes some common items, such as two orange SATA data-transfer cables, a dual-connector SATA PSU connector adapter, and an Ethernet cable.

Our first KV2 Extreme let us into the BIOS once or twice before collapsing, so we returned the board and fired up the replacement, which lets you enter the BIOS without trouble. It froze twice when we tried to install Windows, but once we loaded the OS, the board snapped into action. Unfortunately, it didn't play nicely with our OCZ memory; the board never once completed PCMark04's memory suite. That said, it loved the other benchmarks.

ECS KV2 Extreme

MSI K8T Neo2-FIR

MSI's socket 939 has a rainbow assortment of colored components, including a PCI slot that deserves special attention. The bright orange slot functions fine as an ordinary PCI 2.3-card port, but MSI designed the port to control its Wi-Fi card (not included). MSI's Windows-based DigiCell software, which has the card's features, takes advantage of some nonstandard PCI definitions to manipulate the card.

If you're a FireWire fan, you'll love this board. MSI added two external FireWire (400Mbps) ports, one of which is a mini port, and an internal FireWire connector that can handle your chassis' front panel FireWire port. MSI didn't skimp on USB ports either; the board has eight USB 2.0 ports (the southbridge's maximum) in the form of four external connectors and two dual-port internal connectors.

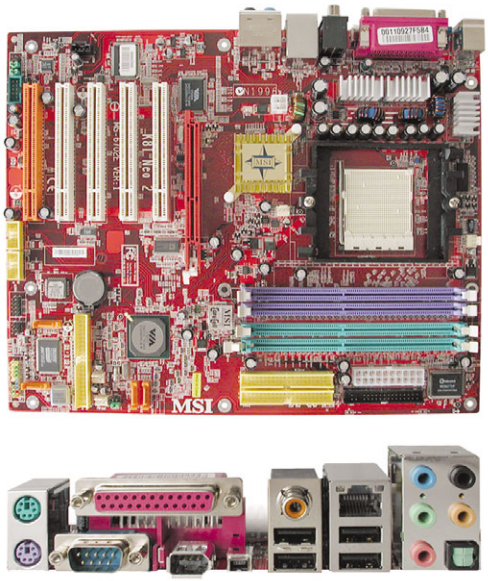
Music lovers will appreciate the Realtek ALC850, which provides eight-channel audio. The I/O area boasts several extra audio ports, including S/PDIF-out ports and ports for the rear speaker and subwoofer. The board has plenty of RAID options, thanks to a Promise PDC20579 controller that handles two extra SATA ports and a third IDE port. Both chips support RAID 0 and RAID 1. The K8T Neo2-FIR also has a single Gigabit LAN port.

As with some of the other boards in this roundup, MSI skipped the northbridge fan and stuck with an aluminum heatsink. We don't have any complaints about the heatsink, but if there's not already enough noise in your life, you can pop it off and use the nearby fan header to power a chillier heatsink/fan combo.

MSI gives you plenty of accessories, including a USB extension module that also houses a four-LED PC status/troubleshooting system. If your PC has trouble, you can match the module's LED pattern to the manual's list of patterns and troubleshooting information. The package also includes two SATA connectors, ribbon cables, and a SATA PSU connector adapter.

One of DigiCell's coolest components is the CoreCenter, which shows many of the same temps and fan speeds that your BIOS displays and lets you change several voltages, including the Vcore voltage. Of course, it also lets you change the FSB (although it doesn't have a multiplier

Performance Comparison				
MSI K8T Neo2-FIR				
Benchmark	**AMD Athlon 64 3500+**	**AMD Athlon 64 3800+**	**AMD Athlon 64 FX-53**	**AMD Athlon 64 FX-53 2.4GHz at 2.52GHz, 1.675V**
3DMark03 Build 340	**5072**	**5113**	**5196**	**5297**
PCMark04 1.2.0	**4058**	**4310**	**4690**	**4693**
CPU	3985	4282	4491	4591
Memory	3116	3158	4827	3437
Graphics	4159	4182	4337	4251
HDD	4497	4429	4457	4507
Halo				
800 x 600	52.98fps	53.93fps	51.23fps	55.88fps
1,024 x 768	47.35fps	47.72fps	44.53fps	48.19fps
1,280 x 1,024	32.14fps	32.19fps	30.93fps	32.3fps
Doom 3				
800 x 600	24.6fps	24.4fps	24fps	24.9fps
1,024 x 768	17.6fps	17.6fps	17.7fps	17.7fps
1,280 x 1,024	11.9fps	12fps	12.1fps	11.9fps



MSI K8T Neo2-FIR

feature). So what's the upside to OCing from Windows instead of the BIOS? The Save feature means you can let your system run at stock until you're ready to fire up a game or run a processor-intensive task and then quickly load your saved OC settings. Thanks to this feature, you won't need to write down or memorize your system's top OC settings, and you won't need to enter them in the CoreCenter when you want to OC.

If you want to overclock the old-fashioned way, you'll find that MSI tweaked the American Megatrends BIOS by putting most of the speed and voltage options into the Cell Menu, which also houses the Cool'n'Quiet feature and MSI's multilevel automatic overclocking feature, Dynamic Overclocking.

Soltek SL-K8TPro-939

If you're the kind of person who won't wear boots during a snowstorm because they don't match your outfit, Soltek has a board it'd like to sell you. From its black PCB to its purple connectors, the SL-K8TPro-939 oozes style. However, Soltek didn't trade in the functionality of colored connectors for fashion; a few yellow connectors help new users find the RAID IDE connector and differentiate between memory slot pairs. Although you won't notice this unless you have your nose a few inches from the board, Soltek colored the USB connectors green and the FireWire (400Mbps) connector red. We're glad to see the colors and nearby labels, as many manufacturers don't differentiate between USB and FireWire connectors adequately.

A small, square device sits just above the floppy connector and flashes two-character codes when your system boots. As with the ABIT AV8-3rd Eye's POST Code Display, Soltek's Debug LED provides codes that indicate the system's status. Unlike the AV8-3rd Eye's LED, however, this board offers only 18 codes and has very brief code descriptions. If we based buying decisions solely on the LEDs, we'd go with the AV8-3rd Eye. That said, some troubleshooting help is better than none at all.

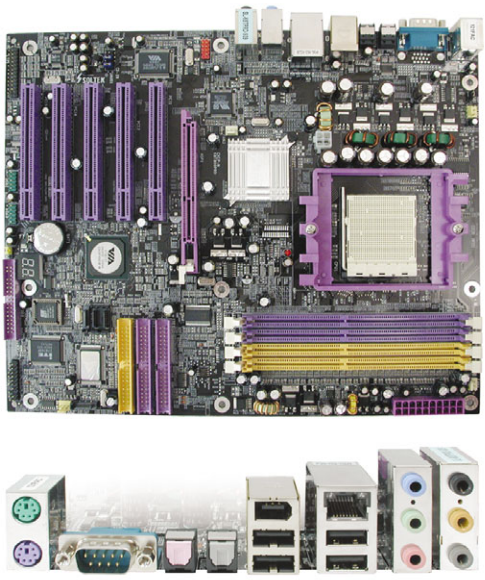
We were surprised to see that the I/O area lacks a parallel port, but we doubt most users will miss the connector. That said, Soltek should have taken advantage of the extra space; instead it simply provides an I/O port shield that covers the parallel port's area. The rest of the I/O area includes S/PDIF ports, several audio ports including back speaker and subwoofer ports (the board has eight-channel integrated audio, thanks to a Realtek ALC850 chip), a FireWire port, four USB 2.0 ports, and a Gigabit LAN port, courtesy of the VIA VT6122 controller.

The K8T800 Pro has only an aluminum heatsink, but users who insist on super-cool chips can easily replace the heatsink, thanks to the traditional two-hole design. The board also has a nearby fan connector that means you can use a heatsink/fan combo. As for storage options, the SL-K8TPro-939 has plenty. The board boasts three IDE connectors and four SATA connectors, thanks to a Promise PDC20579 controller.

System Specs	
Component	**Model**
Motherboard	ABIT AV8-3rd Eye
Motherboard	ASUS A8V Deluxe
Motherboard	ECS KV2 Extreme
Motherboard	MSI K8T NEO2-FIR
Motherboard	Soltek SL-K8TPro-939
Processor	AMD Athlon 64 3500+
Processor	AMD Athlon 64 3800+
Processor	AMD Athlon 64 FX-53
Memory	1GB (512x2) OCZ EL Dual Channel Series Gold Edition 184-pin DDR PC-4400
Video Card	128MB Gainward NVIDIA GeForce FX5900XT FX PowerPack! Ultra/1100XT
Hard Drive	80GB Maxtor 6Y080M0
	SATA 7,200rpm
	8MB cache
Optical Drive	Plextor PX-708A
Chassis	Lian Li PC-65
Operating System	Windows XP Home

Of course, the black-and-purple board wouldn't be so slick if it didn't have matching cables, so Soltek tossed purple ribbon cables and a purple rounded IDE cable into the mix. It also included a whopping four SATA cables, a SATA power cable adapter that supports two hard drives, and a two-port USB expansion module.

The driver CD includes a Windows-based hardware monitor utility that displays the same information your BIOS offers, such as system temperatures, voltages, and fan speeds. The UI also includes a light that warns you if it detects a problem.



Soltek SL-K8TPro-939

With RedStorm2, Soltek has jumped onto the Windows-based overclocking utility bandwagon. Unfortunately, Soltek hasn't worked out the kinks just yet; the included RedStorm2 Beta refused to load. In fact, the software insisted that it wasn't compatible with our motherboard. That's not very encouraging.

Performance

The ABIT AV8-3rd Eye performed very well at stock settings, providing some of the highest benchmark scores in this roundup. We were surprised to find that we couldn't push the CPU frequency very high when we overclocked our test CPUs, but the system pummeled the benchmarks anyway, offering better 3DMark03 and PCMark04 scores than many boards that provided higher CPU clock speeds. The board also performed well when we ran the Doom 3 benchmark, but it didn't make any waves when it tackled the Halo demo.

The ASUS A8V Deluxe landed in the middle at stock settings, providing solid benchmark scores in the synthetic benchmarks and in the game benchmarks. We didn't have any trouble raising the CPU clock speed, but the board screamed for juice, so we bumped it up to 1.675V. The overclocked A8V also landed middle-of-the road scores when we overclocked. The ECS KV2 Extreme got off to a rocky start: The first board died soon after we powered on our system. However, when we replaced our defective board, the KV2 Extreme offered strong scores in most of the benchmarks (it didn't like PCMark04). It also offered solid overclock scores, so if you're brave and looking for a showy performer, take a look at this unpredictable mobo.

We were surprised to find that MSI's K8T Neo2-FIR didn't post particularly high scores at stock settings; we've had better luck with other boards, including the MSI K8N Neo2 Platinum, which boasts NVIDIA's nForce3 chipset. The board let us push the CPU clock speeds quite high, but it didn't produce particularly high scores. That said, it posted very strong frame rates in Halo. Even so, if you're loyal to MSI, you'll probably want to go with the K8N Neo2 Platinum—it offers better stock settings and is overclockable. The Soltek SL-K8TPro-939, on the other hand, provided excellent scores at stock settings in both game and synthetic benchmarks. It also provided solid scores at overclocked settings.

Performance Comparison

Soltek SL-K8TPro-939

Benchmark	AMD Athlon 64 3500+	AMD Athlon 64 3800+	AMD Athlon 64 FX-53	AMD Athlon 64 FX-53 2.4GHz at 2.52GHz, 1.675V
3DMark03 Build 340	**5253**	**5302**	**5314**	**5328**
PCMark04 1.2.0	**4401**	**4712**	**4761**	**4850**
CPU	4132	4454	4503	4603
Memory	5249	5418	5516	5644
Graphics	4352	4369	4340	4401
HDD	4481	4466	4471	4508
Halo				
800 x 600	49.01fps	51.11fps	52.13fps	52.4fps
1,024 x 768	44.49fps	45.37fps	46.63fps	45.85fps
1,280 x 1,024	31.26fps	31.29fps	31.88fps	31.37fps
Doom 3				
800 x 600	24.2fps	25.1fps	24.4fps	25.2fps
1,024 x 768	17.8fps	17.9fps	17.9fps	17.9fps
1,280 x 1,024	12.1fps	12fps	12.2fps	12fps

Final Word

If you simply want the best stock performance around, you're looking for the ABIT AV8-3rd Eye. Although it didn't produce superhuman scores, it clearly dominated the 3DMark03 and PCMark04 benchmarks in this roundup. That said, we don't have any complaints about the other boards' performance (well, we're not too excited about the ECS KV2 Extreme's erratic performance). If you like powerful but classy boards, you'll love the Soltek SL-K8TPro-939. All of these mobos support both traditional Athlon 64 processors and the faster FX series, which means that you'll hang on to your socket 939 board through several upgrades. CPU

by Joshua Gulick

Intel High-End Shootout

Six 925X Boards Go Head-To-Head

There's a new jewel (at least for the time being) in Intel's crown, and it's the 925X chipset. With support for LGA 775 processors, DDR2 memory, and PCI-E, the 925X has a lot in common with Intel's 915 chipsets.

So what makes the 925X better than the 915? Like Intel's 875P, the 925X includes memory enhancements that should make it faster (this time around Intel refrained from giving the technology a lame name like PAT). For those who care, the 925X also adds support for ECC DDR2 memory.

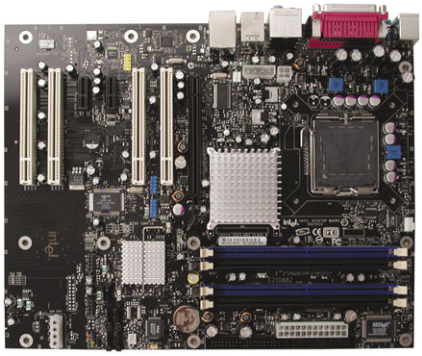
In this article we'll pit six 925X boards head-to-head comparing stability, performance, and features using three different processors. Who has the fastest 925X platform out there? Read on.

Intel D925XCVLK

We'll start our roundup with Intel's D925XCVLK. Intel boards aren't very popular with some enthusiasts because Intel won't let you increase the FSB. Nonetheless, Intel has a reputation for swift and stable motherboards, making Intel a standard when it comes to measuring performance. It's only appropriate that we start off this roundup looking at Intel's D925XCVLK motherboard.

The D925XCVLK includes an ICH6R on the southbridge that supports SATA RAID (up to four drives) and one IDE channel. Intel also includes a Realtek ALC880 7.1-channel high-definition audio codec and a Marvell 88E8050 Gigabit Ethernet controller on this board.

In addition to coaxial and optical SPDIF outputs on the rear I/O panel, you'll also find four USB 2.0 ports and a FireWire 400 port. Intel includes a rear bracket with two extra USB ports plus a FireWire 400 port and a front-panel connector with two more USB 2.0 ports and another FireWire



400 port. The front-panel connector slides into any 3.5-inch drive bay.

We got the kind of performance scores we expected from our Intel motherboard. With a P4 520 running at 2.8GHz, we managed a 4877 3DMark03 score and a 4167 PCMark04 score. Our Halo frame rates were some of the lowest P4 520 frame rates in this roundup. The board rebounded on Doom 3, posting strong P4 520 frame rates.

Our next processor was a P4 540 running at 3.2GHz. Our 4932 3DMark03 score and 4727 PCMark04 score were both very strong. While our Halo frame rates were once again relatively low, our Doom 3 frame rates were among the best frame rates posted with the P4 540.

Our final test processor was a 3.4GHz P4 Extreme Edition. Our 4970 3DMark03 score was just three points shy of the best 3DMark03 score in this roundup, while the PCMark04 score was just two points shy of the best PCMark04 score in this roundup. Halo scores were slightly improved relative to the other boards this time around, while Doom 3 scores continued to be some of the best scores in this roundup.

Intel's D925XCVLK is a moderately priced 925X board at $195. Most of its scores are above average, making the D925XCVLK a pretty decent deal; unless, of course, you're planning to overclock your system.

D925XCVLK
$195
Intel
(800) 538-3373
www.intel.com

Foxconn 925A01-8EKRS

The Foxconn 925A01-8EKRS is similar in features to Intel's D925XCVLK. Unfortunately for the 925A01-8EKRS, it can't quite post the same performance scores as Intel's board.

Foxconn's handy naming convention lets you know exactly what's included on the motherboard. The 8EKRS at the end of the name tells you this board includes 8-channel audio (8), FireWire 400 (E), Gigabit LAN (K), RAID (R), and SATA (S). Like all the boards in this review, the 925A01-8EKRS includes an Intel ICH6R on the southbridge that supports SATA RAID on up to four drives. The ICH6R also supports a single IDE channel.

An included bracket provides two additional USB 2.0 ports. Combined with the four USB 2.0 ports on the back I/O panel, this board supports a total of six USB 2.0 ports out of the box. An extra USB header lets you connect any additional USB ports. Most of the boards in this review put an SPDIF output on the I/O panel, but Foxconn includes a bracket you'll need to attach.

The 4690 3DMark03 score posted by this board with our P4 520 was the lowest

3DMark03 score in this roundup. The 4145 PCMark04 score was also low compared to other boards, but not by as much. The 4328 CPU score was actually one of the better scores for the P4 520, and the 4892 Memory score, while bad, wasn't horrible. The 3545 Graphics score, however, was very low.

Replacing the P4 520 with a P4 540 didn't help much. The 4763 3DMark03 score was still disappointing compared to our other boards with the same processor. The 4621 PCMark04 score was still low, though not as disappointing as the 3DMark03 score.

Despite somewhat disappointing scores, the 925A01-8EKRS did manage to beat up on the Intel board when it came to Halo frame rates. Doom 3, however, didn't seem to run quite as fast on this board.

The 925A01-8EKRS had problems running our 3.4GHz P4 Extreme Edition. The system would power up for a brief second before losing power completely. Foxconn claims the processor should work, but we were unable to find any other problems with our testing equipment.

Even if you're not likely to spend over $1,000 for a 3.4GHz P4 Extreme Edition, the 925A01-8EKRS still posted some disappointing scores. Halo frame rates were below average, although in some instances they were faster than the Intel board. You can find this board for around $175 online, but you can find other 925X boards with better performance for less money.

925A01-8EKRS
$175
Foxconn
(714) 871-9968 ext. 290
www.foxconnchannel.com

DFI LANParty 925X T2

The DFI LANParty 925X T2 isn't just a motherboard, it's an entire kit that targets enthusiasts and gamers. The motherboard comes packed in an enticing kit that includes a case transport, wire sleeving, and DFI's FrontX front-panel accessory. The FrontX is actually a fairly cool design that mounts in a 5.25-inch drive bay and lets you install any configuration of peripheral ports you want. Included are diagnostic

Performance Comparison
Intel D925XCVLK*

Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock
3DMark03 Build 340	4877	4932	4970	
PCMark04 1.2.0	4167	4727	4995	
CPU	4312	4922	5224	
Memory	4907	5184	5296	
Graphics	3689	3720	3727	
HDD	3884	3912	3888	
Halo				
800 x 600	40.78fps	44.06fps	46.05fps	
1,024 x 768	37.19fps	39.39fps	39.61fps	
1,280 x 1,024	27.06fps	27.63fps	27.55fps	
Doom 3				
800 x 600	27.1fps	27.4fps	27.4fps	
1,024 x 768	20.3fps	20.4fps	20.4fps	
1,280 x 1,024	14.0fps	14.0fps	14.0fps	

*No overclocking options

Performance Comparison
Foxconn 925A01-8EKRS**

Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock
3DMark03 Build 340	4690	4763		
PCMark04 1.2.0	4145	4621		
CPU	4328	4935		
Memory	4892	5175		
Graphics	3545	3575		
HDD	3943	3912		
Halo				
800 x 600	41.03fps	43.85fps		
1,024 x 768	38.22fps	39.78fps		
1,280 x 1,024	27.61fps	27.83fps		
Doom 3				
800 x 600	26.7fps	27.0fps		
1,024 x 768	19.9fps	20.0fps		
1,280 x 1,024	13.8fps	13.9fps		

**3.4GHz P4 EE would not run

Performance Comparison
DFI LANParty 925X T2

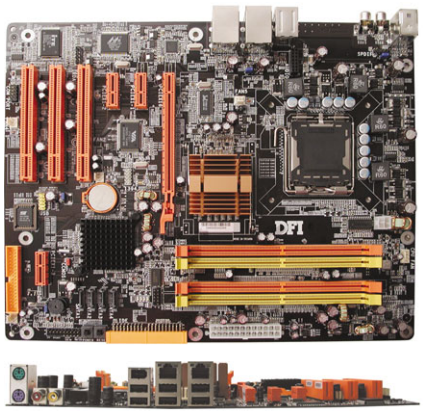
Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.60GHz)
3DMark03 Build 340	4693	4745	4766	4796
PCMark04 1.2.0	4047	4628	4852	5194
CPU	4293	4888	5106	5406
Memory	4873	5129	5146	5472
Graphics	3543	3562	3558	3628
HDD	3900	3909	3932	3927
Halo				
800 x 600	40.62fps	44.24fps	45.08fps	46.47fps
1,024 x 768	37.73fps	40.03fps	40.19fps	40.61fps
1,280 x 1,024	27.34fps	28.06fps	27.85fps	27.86fps
Doom 3				
800 x 600	26.7fps	26.9fps	26.9fps	27.0fps
1,024 x 768	19.9fps	20.0fps	20.0fps	20.1fps
1,280 x 1,024	13.8fps	13.9fps	13.9fps	13.9fps

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Performance Comparison				
GIGABYTE GA-8ANXP-D				
Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.60GHz)
3DMark03 Build 340	4882	4942	4973	4991
PCMark04 1.2.0	4161	4701	4997	5209
CPU	4313	4935	5118	5486
Memory	4871	5180	5284	5455
Graphics	3682	3718	3723	3720
HDD	3879	3878	3989	3920
Halo				
800 x 600	42.93fps	43.84fps	45.59fps	46.10fps
1,024 x 768	39.40fps	39.76fps	40.45fps	40.59fps
1,280 x 1,024	27.97fps	27.90fps	27.93fps	27.98fps
Doom 3				
800 x 600	27.2fps	27.4fps	27.4fps	27.5fps
1,024 x 768	20.3fps	20.4fps	20.4fps	20.4fps
1,280 x 1,024	14.0fps	14.0fps	14.0fps	14.0fps

Performance Comparison				
ABIT AA8-DuraMAX				
Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.65GHz)
3DMark03 Build 340	4714	4767	4789	4857
PCMark04 1.2.0	4175	4765	4992	5273
CPU	4391	5028	5130	5489
Memory	5010	5293	5414	5720
Graphics	3551	3563	3591	3689
HDD	3933	3930	3918	3908
Halo				
800 x 600	43.21fps	49.86fps	46.21fps	47.26fps
1,024 x 768	39.10fps	39.87fps	40.62fps	41.33fps
1,280 x 1,024	27.90fps	27.81fps	27.88fps	28.17fps
Doom 3				
800 x 600	26.7fps	27.0fps	27.0fps	27.2fps
1,024 x 768	19.9fps	20.0fps	20.0fps	20.2fps
1,280 x 1,024	13.9fps	13.9fps	13.9fps	14.0fps

Performance Comparison				
ASUS P5AD2 Premium				
Benchmark	Pentium 4 520 2.8GHz	Pentium 4 540 3.2GHz	3.4GHz P4 Extreme Edition	3.4GHz P4 Extreme Edition Overclock (3.61GHz)
3DMark03 Build 340	4855	4913	4920	4930
PCMark04 1.2.0	4157	4619	4962	5150
CPU	4250	4854	5140	5209
Memory	4852	5089	5202	5500
Graphics	3678	3714	3722	3771
HDD	3974	3894	3875	3958
Halo				
800 x 600	42.70fps	45.40fps	47.61fps	48.06fps
1,024 x 768	38.45fps	39.80fps	40.53fps	40.70fps
1,280 x 1,024	27.94fps	27.91fps	27.93fps	27.96fps
Doom 3				
800 x 600	27.1fps	27.4fps	27.4fps	27.5fps
1,024 x 768	20.2fps	20.3fps	20.4fps	20.4fps
1,280 x 1,024	13.9fps	14.0fps	14.0fps	14.0fps



LEDs, a FireWire 400 port, an optical SPDIF output, and an external SATA port. You can mount any or all of these items into the FrontX before installing it to the drive bay. The kit also has all the necessities; SATA cables, SATA power converters, and rounded IDE and floppy cables.

The board has some unique design aspects. The 925X T2 was one of the few boards we saw that features 3 PCI-E x1 slots and three PCI slots. One PCI-E x1 slot, however, is located directly above the floppy connector on the bottom right quarter of the board, limiting its usefulness. The audio codec and audio jacks come on a small separate daughterboard that plugs into a proprietary header on the motherboard. The daughterboard comes with two-sided tape to secure the jacks and the audio codec to the board. The board also includes a SATA-to-IDE converter. The converter plugs into the back of an IDE hard drive and lets you connect the drive to a standard SATA port. The motherboard also includes built-in power and reset switches.

In addition to the semi-integrated audio, the 925X T2 includes integrated Marvell 88E8053 and 88E8001 Ethernet controllers that provide two RJ-45 Gigabit Ethernet ports on the back I/O panel. The VIA VT6307 supports two FireWire 400 ports. The back I/O panel includes six USB 2.0 ports, two more than you normally find on a motherboard. An additional USB header lets you connect two more USB ports if your system has them available.

All the extras push the price of the LANParty 925X T2 kit above the $200 mark, and we didn't find the board's performance consistent with its price. With a P4 520 processor, the 925X T2 managed a

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

System Specs	
Component	**Model**
Processor	Pentium 4 520 2.8GHz
Processor	Pentium 4 540 3.2GHz
Processor	3.4GHz Pentium 4 Extreme Edition
Memory	1GB (512x2) OCZ Platinum Enhanced PC4200 DDR2
Video Card	128MB Chaintech NVIDIA GeForce PCX5900
Hard Drive	80GB Maxtor 6Y080M0 SATA 7,200rpm 8MB cache
Optical Drive	Pioneer DVR-108 DVD±RW
Chassis	Cooler Master Wave Master
Operating System	Windows XP Home

meek 4693 3DMark03 score. This was just three points better than the lowest P4 520 3DMark03 score we received. The 4047 PCMark04 score was worse; it was the lowest PCMark04 score in this roundup.

Installing a P4 540 processor changed things a little bit. Our 4745 3DMark03 score became the lowest P4 540 3DMark score in this roundup, while our PCMark04 score increased to 4628, seven points better than the Foxconn's P4 540 score.

Our 3.4GHz P4 Extreme Edition didn't help scores enough. The 4766 and 4852 3DMark03 and PCMark04 scores were the lowest 3.4GHz P4 EE scores in this roundup.

Given the benchmark scores, it wasn't surprising that Halo and Doom 3 frame rates were also below average. This board did manage to rise up and post some better scores at certain resolutions, but even its good scores weren't that good compared to the better boards in this review.

When it comes to overclocking, however, the 925X T2 may be the second-most overclockable board in this roundup next to the ASUS board. Even with the P4 540 overclocked to 3.58GHz, however, the 925X T2's 3DMark03 score was still almost 100 points lower than the stock 3DMark03 score posted by the ASUS board. The 5146 overclocked PCMark04 score, however, was probably the most impressive score we saw from this board.

Some of the extras included in the LANParty kit are kind of cool, but most seem a little lame (the audio card, for instance). Given the low scores, we're not sure this board's worth its price.

LANParty 925X T2
$203
DFI
(916) 568-1234
www.dfi.com.tw

GIGABYTE GA-8ANXP-D

Like the DFI LANParty 925X T2, the GIGABYTE GA-8ANXP-D comes with a number of compelling features, including an 8-phase power converter, eight SATA connectors, and 802.11g support.

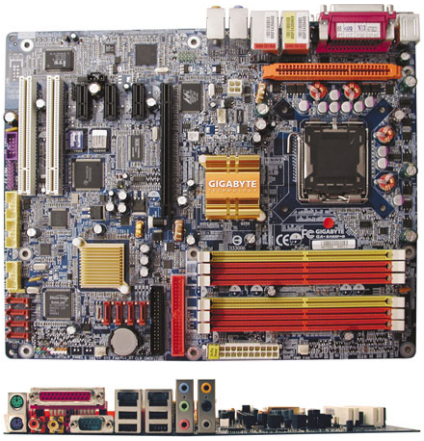
The 8-phase power converter is nothing new to GIGABYTE boards, but this is one of the first DPS units to feature passive cooling to help reduce noise. A copper heatpipe directs heat down to copper fins that rest below the processor. From this position the copper fins can benefit from cool air being drawn by the processor's fan.

Like all the other boards in this review, the GA-8ANXP-D includes an ICH6R on the southbridge. The ICH6R supports SATA RAID on the four SATA connectors it controls. Unlike the other boards in this review, this mobo doesn't stop with four SATA devices. It includes a Silicon Image controller that provides SATA RAID on four additional SATA connectors. Despite all the support for SATA, the GA-8ANXP-D only supports the single IDE channel controlled by the ICH6R.

GIGABYTE didn't integrate 802.11g directly into the motherboard like ASUS, but GIGABYTE did include an 802.11g PCI card. We prefer the integrated Wi-Fi provided by ASUS a little more because it doesn't require the use of a PCI slot.

The Texas Instruments TSB82AA2 provides FireWire 800 support via a motherboard header. An included bracket provides two FireWire ports while an additional header lets you connect any remaining FireWire ports on your system. The FireWire bracket includes two additional USB ports as well. A separate bracket includes three additional USB ports.

The GA-8ANXP-D actually posted some of the best 3DMark03 scores in this roundup, regardless of processor. While our PCMark04 scores weren't as dominant, they were still above average. With a P4 520 installed, we scored a 4882



3DMark03 score and a 4161 PCMark04 score. Upgrading the processor to a P4 540 increased our 3DMark03 score to 4942 and our PCMark04 score to 4701. Finally, with a 3.4GHz P4 EE installed, we managed a 4973 3DMark03 score and a 4997 PCMark04 score.

The GA-8ANXP-D also did an excellent job with frame rates. With a 3.4GHz P4 EE installed, we averaged 27.93fps in Halo at 1,280 x 1,024. With Doom 3 set to High Quality, we managed 14.0fps at 1,280 x 1,024.

The GA-8ANXP-D does a nice job of combining performance with a nice feature package, but it doesn't come cheap.

GA-8ANXP-D
$241
GIGABYTE
(626) 854-9338
www.gigabyte.com

ABIT AA8-DuraMAX

The ABIT AA8-DuraMAX may not be loaded with the kind of performance and features we found on the GIGABYTE and ASUS boards, but at around $150 it is the least expensive board in this roundup.

Like all the other boards in this review, the AA8 includes an ICH6R on the southbridge that provides SATA RAID support. The ICH6 also supports this board's only IDE channel and eight USB 2.0 ports.

Integrated components include a Realtek ALC860 high definition audio codec and a Realtek RTL8110S Gigabit Ethernet controller. A Texas Instruments TSB43AB23 FireWire controller supports up to three FireWire 400 ports. One FireWire port

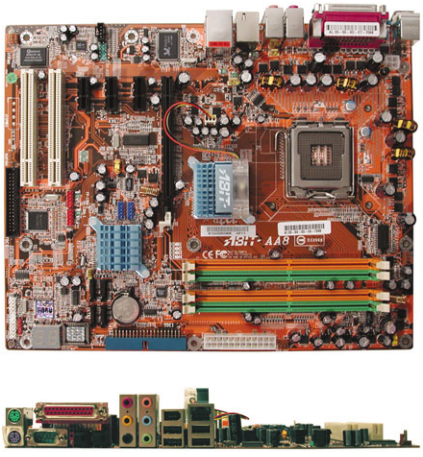
CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

comes integrated on the I/O panel. An included bracket contains two more FireWire 400 ports along with two additional USB ports. An additional USB header lets you connect two USB ports. Four USB ports are included on the I/O panel.

Most boards include coaxial SPDIF outputs only or a mixture of optical and coaxial outputs. The AA8, however, supports a lone optical SPDIF output. An optical SPDIF input is available, as well.

From a performance standpoint, the ABIT was barely more effective than the DFI and Foxconn boards. With our P4 520 installed, we received a 3DMark03 score of 4714, just slightly above the score posted by the Foxconn board. Our 4175 PCMark04 score was much better; it was the best P4 520 score in this roundup. With the P4 540 installed, the story changed very little. The 3DMark03 score increased to 4767; only a few points better than the lowest P4 540 score. Our 4765 PCMark04 score was the best P4 540 score posted. We scored a 4789 3DMark03 score with our 3.4GHz P4 EE installed; just a few points above the lowest 3.4GHz P4 EE score. The 4992 PCMark04 score was five points below the high score posted by the GIGABYTE board. Halo scores ran from above average to very good, while Doom 3 scores tended to be a little below average.

While the AA8-DuraMAX's 3DMark03 scores were disappointing, we loved the PCMark04 scores and received decent Halo and Doom 3 frame rates despite the low 3DMark03 scores. With this board's price tag, we're even more forgiving of the 3DMark03 scores.



AA8-DuraMAX
$152
ABIT
(510) 623-0500
www.abit-usa.com

ASUS P5AD2 Premium

With the P5AD2 Premium, ASUS managed to combine an excellent list of features with solid performance and great overclocking capabilities.

The P5AD2 Premium starts with an ICH6R that supports SATA RAID on four devices. The ICH6R only supports one IDE channel, but the P5AD2 Premium adds an ITE8212F controller that supports SATA RAID on two additional IDE channels. Add a Silicon Image 3114R controller that supports SATA RAID on four additional SATA connectors and the P5AD2 easily has the most flexible storage options of any board in this roundup.

A Marvell 88W8310 controller provides 802.11g functionality. The integrated wireless features are compatible with either 802.11g or 802.11b. This board also includes two Marvell 88E8053 Gigabit Ethernet controllers. One RJ-45 connector resides on the back I/O panel, while the second resides on an included bracket with two FireWire 800 ports.

When it comes to performance, the P5AD2 put up some strong scores, including a 4855 3DMark03 score with a P4 520 processor. The 4157 PCMark04 score was disappointing, however. With a P4 540 installed, the PCMark04 score was actually worse relative to other P4 540 scores. The 4619 was the lowest P4 540 PCMark04 score recorded. The 5089 Memory score was particularly bad. The 4913 3DMark03 score, however, was excellent, coming in just behind P4 540 scores from Intel and GIGABYTE. Our 3.4GHz P4 EE seemed to improve the P5AD2 Premium's PCMark04 standing a little. The 4962 PCMark04 score was better than the score posted by our DFI board. The 4920 3DMark03 score came in just behind GIGABYTE and Intel.

ASUS, however, probably did the best job with Halo and Doom 3 frame rates. With the 3.4GHz P4 EE, we averaged

27.4fps in Doom 3 at 800 x 600 and 47.61fps in Halo at the same resolution.

When it comes to overclocking, the P5AD2 was easily the best board in this roundup. We easily pushed the FSB up to 247MHz with the P4 520. Increasing the FSB also helped our PCMark04 scores. We managed a 5039 PCMark04 score with the 2.8GHz P4 520 running at 3.46GHz.

At $261, however, the P5AD2 doesn't come cheap. Nonetheless, this board easily has the best package in this roundup.

P5AD2 Premium
$261
ASUS
(502) 995-0883
usa.asus.com

King Of The Road

For those on a budget, you can't beat the ABIT AA8-DuraMAX's combination of price and performance, but our favorite package is the ASUS P5AD2 Premium. Although its PCMark04 scores were below average, its 3DMark03 scores were strong and its game frame rates were excellent. Add those scores to the best feature package in this review, and you've got a winner.

The real question, however, is whether 925X boards are worth the extra cost at this point. All of our performance scores were very similar to scores from 915 boards we looked at earlier. Until PCI-E x16 and DDR2 components really start pushing the capabilities of these new technologies, it might be wise to save some money and stick with a 915 board. CPU

by Chad Denton

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Intel D925XCVLK	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	4
PCI-E x1	2
SATA Ports	4
IDE	1
USB Ports	8 Total; 4 onboard, 4 via headers
FireWire Ports	3 FireWire 400 (1 on motherboard)
LAN	Marvell 88E8050
Integrated Audio	Realtek ALC880 7.1-channel high definition audio codec
Integrated Graphics	None
Other Features	Front panel accessory with USB and FireWire Port
Manufacturer	Intel
Phone	(800) 538-3373
URL	www.intel.com
Price	$195

Foxconn 925A01-8EKRS	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	2
PCI-E x1	3
SATA Ports	4
IDE	1
USB Ports	8 total; 4 onboard, 4 via USB headers onboard
FireWire Ports	1 FireWire 400
LAN	Realtek 8110S
Integrated Audio	Realtek ALC880 7.1-channel high definition audio codec
Integrated Graphics	None
Other Features	SuperUtilities software (SuperBoot, SuperBIOS-Protect, Super Recovery, SuperSpeed, SuprStep, SuperLogo, and Super Update)
Manufacturer	Foxconn
Phone	(714) 871-9968 ext. 290
URL	www.foxconnchannel.com
Price	$175

DFI LANParty 925X T2	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	3
PCI-E x1	3
SATA Ports	4
IDE	1
USB Ports	8 total; 6 onboard, 2 via USB headers onboard
FireWire Ports	2 FireWire 400 Ports (1 on motherboard)
LAN	Marvell 88E8053 PCI-E Gigabit Ethernet Controller; Marvell 88E8001 PCI Gigabit Ethernet Controller
Integrated Audio	Realtek ALC880 7.1-channel high definition audio codec
Integrated Graphics	None
Other Features	FrontX custom front panel connectors, WinFlash, Hardware Monitoring Software
Manufacturer	DFI
Phone	(916) 568-1234
URL	www.dfi.com.tw
Price	$203

GIGABYTE GA-8ANXP-D	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	6
Graphics Bus	PCI-E x16
PCI Slots	2
PCI-E x1	3
SATA Ports	8 (4 via ICH6R; 4 via Silicon Image 3114)
IDE	1
USB Ports	8 total; 4 onboard, 4 via USB headers onboard
FireWire Ports	3 FireWire 800 (2 on included bracket; 1 via header)
LAN	Broadcom 5751 PCI-E Gigabit Ethernet; Marvell 8001 PCI Gigabit Ethernet
Integrated Audio	Realtek ALC880 7.1-channel high definition audio codec
Integrated Graphics	None
Other Features	U-PLUS DPS 8-phase power converter, EasyTune, @BIOS, 802.11g PCI Card
Manufacturer	GIGABYTE
Phone	(626) 854-9338
URL	www.gigabyte.com
Price	$241

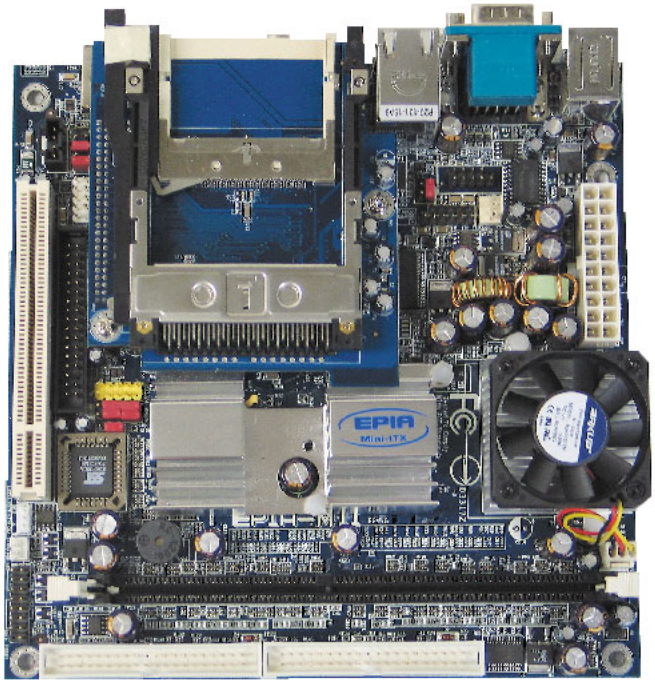
ABIT AA8-DuraMAX	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	2
PCI-E x1	3
SATA Ports	4
IDE	1
USB Ports	8 total; 4 onboard, 4 via USB headers onboard
FireWire Ports	3 FireWire 400 (1 on motherboard, 2 on bracket)
LAN	Realtek RTL8110S
Integrated Audio	Realtek ALC860 7.1-channel high definition audio
Integrated Graphics	None
Other Features	uGuru
Manufacturer	ABIT
Phone	(510) 623-0500
URL	www.abit-usa.com
Price	$152

ASUS P5AD2 Premium	
Socket Type	LGA 775
Chipset	Intel 925X
Processor Support	Pentium 4 LGA775 processors
RAM Support	Dual channel 4GB DDR2 400/533
RAM Slots	4
Graphics Bus	PCI-E x16
PCI Slots	3
PCI-E x1	2
SATA Ports	8
IDE	3
USB Ports	8 total; 4 onboard, 4 via USB headers onboard
FireWire Ports	3 FireWire 400 and 2 FireWire 800
LAN	2 Marvell 88E8053 Gigabit Ethernet Controllers; Marvell 88W8310 802.11g
Integrated Audio	C-Media CMI9880 7.1-channel high definition audio codec
Integrated Graphics	None
Other Features	Wi-Fi antenna, Post Reporter, Q-Fan2, CrashFree BIOS 2, MyLogo 2, PC Probe, Live Update Utility, Norton Antivirus
Manufacturer	ASUS
Phone	(502) 995-0883
URL	usa.asus.com
Price	$261

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Mighty Mites

Attack Of The Mini-ITX Motherboards



VIA EPIA MII12000

Initially, there was no cause for alarm. The mighty mites were largely an Asia-Pacific phenomenon. Then came a well-documented invasion of the UK. Today, there's no denying that mini-ITX mainboards have migrated to North America, and they're giving the United States a case of the tinies.

Mini-ITX boards make even XPC-sized units look big and gangly. At just 6.7 inches (17cm) square, mini-ITX models are fascinating case studies in efficient use of space. Chipset powerhouse VIA did the majority of the trailblazing in this less-is-more milieu, and the company still carries the most clout among its mostly Taiwanese competitors.

In contrast to XPC boards, some of which can vie with enthusiast desktop PC mobos in speed and device support, most mini-ITX offerings are designed for low-power operation. Some are so modest in their power demands that they don't even need any cooling fans. If you've been wondering how to make the quietest PVR possible, or how to fit a homebrew music server in your dashboard, you're looking for mini-ITX.

This year has brought us several cool new models, especially from VIA. A few products weren't yet available to us in time for this issue, but you'll find the rest here.

How We Tested

None of the four VIA boards in this article had removable processors, so we had to forgo the three-chip testing we did in the other motherboard reviews in this issue. Also, none of the mini-ITXs had much native support for overclocking, so we left that out, too. Overclocking could negate a few of mini-ITX's strengths—namely low wattage and near-silent operation—although there are some explorers out there pushing the possibilities. We'll see what later generations offer in the way of clock tweaks.

Each board in this roundup had only one memory module slot, so we fitted each with one 512MB OCZ EL Gold 184-pin DDR PC4400 DIMM, as supported. Few mini-ITX boards have SATA connectors thus far, so for a hard drive we chose an ATA/100 Seagate 7200.7 160GB with an 8MB cache. Our power supply was a 431W Enermax Whisper EG465P-VE. Some boards required components different from these, so we noted those in the appropriate reviews below. Finally, we added an NEC ND-3500A double-layer DVD±RW drive to each board and then installed Windows XP Pro and DirectX 9.0c.

For software tests, we ran the usual PCMark04 and 3DMark03 benchmarks. You don't buy a mini-ITX board to play Halo or Doom 3, but we kept these games in the testing regimen for continuity with the other mainboard reviews in this issue. Only the Pentium 4 board could run them, however.

Futuremark's new 3DMark05 arrived just before our testing commenced. Unfortunately, none of our boards was up to it. This wasn't surprising, though, as we've seen relatively recent mainboards and video cards brought to their knees by 3DMark05. (We can't wait to see the airship vs. leviathan scenario played out on an SLI system, but wait we must for the moment.)

On a side note, we had a sixth board for this article, an iBase MB870. Alas, alackaday. It was not meant to be. We weren't too concerned when we opened the box to find the driver installation CD broken down the middle. That soon changed as we

couldn't find replacement drivers anywhere online. Queries to iBase's tech support in various countries and several resellers only netted us an FTP download site—for a different chipset—and a promise of a replacement CD that still hadn't arrived by deadline. We even tried reference drivers from ATI, which made the MB870's chipset, but said drivers caused more problems than they solved.

The reason we're telling you all this is to illustrate that mini-ITX is still kind of a wooly frontier as motherboards go. Once you stray too far from the VIA path, you can encounter unbranded boards and spotty support. This may change as the form factor piques more interest on this continent. Of course, if you don't mind a challenge finding tech support, you may prefer the quantum leap in power of a P4 board.

VIA EPIA MII12000

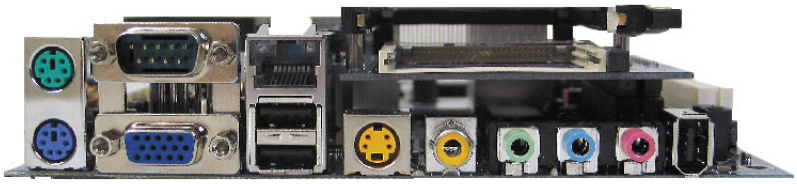
The EPIA board probably best suited to most users is the MII12000. No, it doesn't have the CN400 chipset VIA announced last spring, but that northbridge has only recently shown its face in VIA's new Nano-ITX EPIA N line. Until VIA pairs up the CN400 with a 1.2GHz or 1.4GHz C3 processor, the MII12000 is still the heavy hitter in the company's dugout.

Our MII12000 came with a C5P-cored C3 embedded (permanently mounted) processor with support for VIA's Padlock AES encryption/decryption feature (more on that at www.via.com.tw/en/initiatives/padlock/hardware.jsp). As VIA's naming convention indicates, the C3 "Nehemiah" runs at 1.2GHz. It has exclusive 64KB/64KB L1 and 64KB L2 caches, and a 133MHz frontside bus in this case. The C3 also supports MMX and 3DNow!.

Still the trendsetter in new features, VIA bolted a rather interesting horizontal daughtercard to the MII series. It's a Ricoh combination CardBus Type I/II and CompactFlash slot. This addition opens up new possibilities for the MII12000 as the basis for a digital photo repository or wireless node. You could also use a PC Card hard drive and skip cabling altogether. Underneath that domineering feature is the CMOS battery, the LPT port pin header, and an optional header for LVDS (low voltage differential signaling) LCD video output, which our board didn't have.

Like the rest of the mini-ITX boards in this group, the MII12000 has one DDR DIMM slot and a 1GB memory ceiling. A gentle Arkua ball-bearing fan cools the processor's heatsink, but the chipset shares a one-piece passive sink. There's a full complement of ATA/133 and floppy headers, plus FireWire 400, 10/100Mbps Ethernet, and a couple of built-in USB 2.0 ports.

Driving the three audio jacks is a VT1616 six-channel codec supplying what VIA has dubbed Vinyl Six-TRAC audio. Behind the S-Video and composite video outputs is the other half of the DVD playback equation. Integrated graphics support comes courtesy of the CLE266 northbridge. The UniChrome Pro is no LAN party brawler, but it does feature MPEG-2 acceleration and motion compensation. By the by, that yellow RCA port doubles as a SPDIF audio out or composite video out, depending upon a jumper setting. Speaking of settings, the traditional VIA users manual falls somewhere between adequate and thorough but leaves out any information on Padlock.

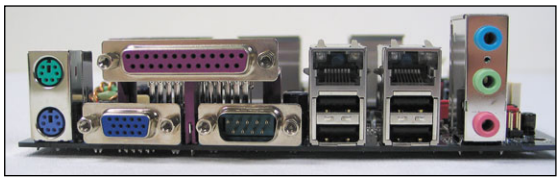


The MII12000's CardBus/CF combo slot may dominate its skyline, but there's also S-Video out, SPDIF or composite video out, and 5.1 VIA Vinyl Six-TRAC audio.

3DMark05, Halo, and Doom3 all refused to run on this board, but we really didn't expect them to. Like the rest of the VIA boards in this article, the MII12000 played second fiddle to the Pentium 4-based MITX-845GVD in the other benchmarks. With that said, the MII12000 took the silver medal in all categories but one. Among the VIAs, the hard drive performance rating ironically went to the board with the slowest CPU.

VIA EPIA PD10000

The EPIA PD series takes a different tack. Lacking floppy drive support or the MII series' CardBus/CompactFlash slot, the PD10000 instead concentrates on network and legacy connections. There's no FireWire here, but there are integrated serial and parallel ports and dual 10/100Mbps Ethernet jacks. VIA suggests that the two LAN ports make this board a good candidate for a custom firewall. The wake-on LAN feature, shared with the MII series, could come in handy here.



The EPIA PD10000's second 10/100 jack makes it a natural for a custom firewall.

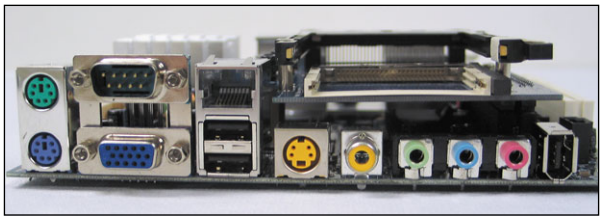
The PD10000 also makes a decent USB 2.0 hub. Four hard-mounted ports man the back ramparts, and there's a header onboard for two more. Other pin headers keep the light on for up to three additional 9-pin serial ports. Like our MII12000 board above, our PD10000 didn't have the optional 40-pin LVDS connector for LCD displays, but the serial and USB connections offer other avenues to the same destination. Our board also had a 12-pin DIO (digital I/O) pin header for point-of-sale equipment use, further expanding the potential of this rather specialized EPIA.

No, those three audio jacks in the back I/O area aren't dual-purpose, as are the trios found on most mobos with integrated surround sound. The sound codec is stereo, so the jacks just play the traditional line-out, line-in, and mic-in roles. And although there is a VGA output for the Unichrome Pro 2D and 3D graphics

engine in the northbridge, there is no provision for TV-out.

The PD10000's 1GHz C3 processor has similar specs to the 1.2GHz edition described in the previous review. Its 133MHz external clock kept our PC4400 DDR pulsing at PC2100 speeds, aka DDR266. The Nehemiah chip supports MMX, SSE, and other extensions and has 128KB total L1 and 64KB of L2 cache. Speedwise, this board dogged the MII-12000's steps, edging out the EPIA TC10000 in all categories except for hard drive management and 3DMark03 tests.

You could try to rectify any one of the PD10000's shortcomings with an appropriate PCI card, but it won't pay to try to make it into something it's not. Take it for what it is, an heir to the EPIA CL series, and choose it advisedly.



Apart from its fanless, 600MHz Eden processor, the MII6000E has most of the features and ports of the MII12000.

VIA EPIA MII6000E

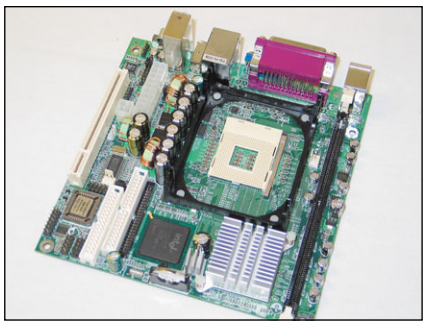
A few years back, VIA decided to take the path less traveled in the face of megahertz madness. The company pressed on with low-power CPU designs influenced by Cyrix and other acquisitions. The payoff came in the form of the Eden, a design so efficient that it doesn't even need a fan on its heatsink. The computing world hasn't seen the likes of that concept in a mainstream processor since Intel's 80486, yet the Eden can run at 600MHz or more. Now that's cool.

The EPIA MII6000E costs a smidgen more than the speedier MITX-845GVD below, but that $182 price includes the processor in the MII6000E's case. The board we bought had a 600MHz Eden ESP chip with a Samuel 2 (Model 7) core. This 133MHz FSB processor has exclusive 64KB/64KB L1 and 64KB L2 caches. It also supports MMX and 3DNow!. The later Nehemiah-core Eden (Model 9) supports SSE instead of 3DNow!, VIA says. Another difference between the two cores is that our Samuel 2 Eden had a 12-stage integer pipeline, in contrast to the Nehemiah Eden's 16-stage pipe. Regardless, all Eden ESPs thus far share an embedded ball grid array similar to Socket 370's physical layout, although the "ESP" indicates permanent mounting.

Look past the lower clock speed and absence of fans, and this MII board looks a lot like the MII12000 above. You'll see the same FireWire 400 port, S-Video and composite video outputs, and two USB 2.0 ports. Overseeing it all, with a 10/100Mbps LAN connection riding shotgun, is the useful CardBus/PC Card and CompactFlash combo slot. Directly below that is VIA's Vinyl Six-TRAC 5.1-channel audio.

Our board didn't have the optional LVDS pins for a compatible LCD display, although it did have a 9-pin serial port and others available via pin headers. As was common to our mini-ITX selections, no extension cable came with the MII6000E to enable that serial pin header, although some might come built into a case. Also like the other boards here, the MII6000E came with an I/O shield, a floppy ribbon, and an ATA/133 ribbon, plus an installation CD, printed users manual, and a case badge.

The power-saving 600MHz Eden ESP turned in PCMark04 CPU and Memory scores less than half of the MII12000's 1.2GHz C5P Nehemiah, as you would expect. With less CPU grunt to help it along, the MII6000E's Graphics rating dropped, as well. 3DMark03 ran—or rather walked—on the MII-6000E, but the game benchmark wouldn't give us an overall score at the end. It goes without saying that 3DMark05, Halo, and Doom 3 were lost causes on this Taiwanese tip-toer. Still, the silent board turned in the second-best hard drive management score of the group. Go figure.



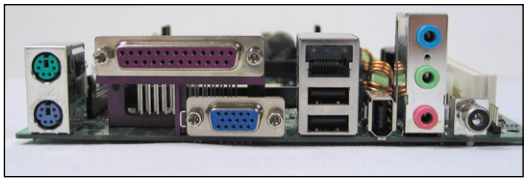
MITX-845GVD

MITX-845GVD

Pentium 4-compatible mini-ITX boards typically come with chipsets from about two generations back. This one wears Intel's i845GV chipset (MCH/ICH4) to support Celerons and Pentium 4s with HyperThreading (400/533MHz FSB). However, its origins carry a bit of mystery. Somebody was so proud of this board that they struck any claim of manufacture from it. Even the users manual says, "Copyright 2003 by this company." The only bit of identification we found was on the BIOS update page: the URL www.Qniq.com.tw. We didn't find any actual BIOSes available to download for this board on that site, but at least our MITX-845GVD no longer feels like such an orphan.

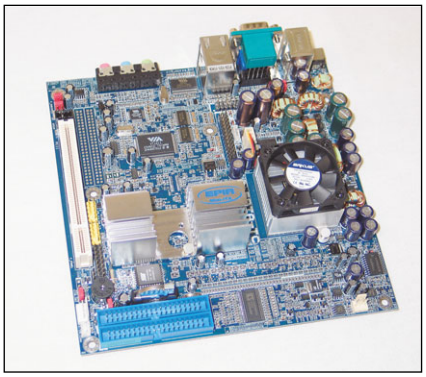
This board has a regular mPGA ZIF Socket 478, so you can remove and replace the CPU as you like. The downside, besides a noisier heatsink fan and higher power requirements, is that the heatsink bracket takes up a quarter of the board's area. In a mini-ITX form factor, that's a whole lotta real estate. And for some reason, our MITX-845GVD didn't come with the S-Video and composite TV outputs we expected to get, nor the optional extra FireWire headers.

Mind you, we can't complain terribly much. After we slipped in a 3.06GHz P4



Our particular MITX-845GVD lacked the S-Video and composite video outputs, but it did have a coaxial SPDIF input/output jack.

with a 533MHz fsb and 512MB L2 cache, this mighty mite took the group's benchmark scores to a new level. An EPIA board with Padlock, such as the MII12000 described above, may beat this P4 midget

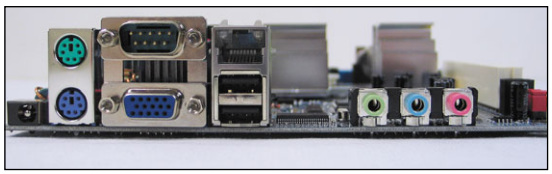


VIA EPIA TC10000.

in most encryption tasks. Apart from that, of course, there's really no comparison. P4-compatible boards simply take another road than the VIAs.

The MITX-845GVD wouldn't recognize our Seagate drive, even to allow a fresh installation of WinXP, so we swapped in a WD1200JB substitute from Western Digital. There are only two EIDE headers on this board, and one is a small 44-pin version for 2.5-inch drives (cable included). Fair enough, but if you're using a 3.5-inch hard drive, you'll have to let it share a cable with your optical drive. That will slow things down a bit on the EIDE bus. An alternative is to convert the big drive's cable with a 44-pin to 39-pin data and power adapter ($9; www.logicsupply.com/product_info.php/products_id/165).

If you could expect to play games on any of these mini-ITXs, this would be the board. Of course, you'd have to settle for older titles than the ones in our test suite. "Extreme" Graphics or no, Doom 3 at High detail setting wasn't even a slideshow on this integrated graphics board. It was a still life. Low detail wasn't much better, but at least it gave us some single-digit FPS results. The 1,280 x 1,024 setting looked to yield about 1fps, by the way, before hanging at the same point in each test run. Try some earlier games at modest resolutions, perhaps using the best PCI graphics adapter you can find, and you should be OK.



The TC10000 only accepts power through a jack on the far left. A standard 12V/5a inline transformer or wall wart will do. By the way, it's stereo audio only.

VIA EPIA TC10000

There's gotta be a weirdo in every crowd, and the TC10000 is ours. First of all, it won't accept a traditional power supply. Instead, it needs a 12-volt, 5-amp, AC-DC transformer. All power shunts into a single two-pole connector in the backplane, next to the mouse and keyboard PS/2 ports. After a bit of scrounging, our hardware mistress found us an EdacPower EA1050A-120 power adapter that worked perfectly in this role. You can find a substitute for about $25 at store.mini-box.com/ituner/ac12v5asw-poa.html.

Without a typical PC power supply, the TC10000's next problem is how to spin up its drives. VIA thoughtfully includes an extender cable that connects to a floppy-style power header on the motherboard. The cable's other diskette connector and two 4-pin Molex connectors can then power a hard drive, an optical drive, and a floppy, for example.

Finally, the TC10000 takes a DDR266 SODIMM memory module instead of a DIMM. The 200-pin slot is mounted flat against the underside of the board. The SODIMM isn't necessary from a space-saving perspective—a DIMM would hardly be taller than the

Performance Comparison

As Robert Plant said, yes, there are two paths you can go by. Mini-ITX boards either offer quiet, low-power processing, as in VIA's EPIA line, or moderate noise and performance levels, as in the Pentium 4 offerings. The difference between the two roads is clear in our test results.

Benchmark	VIA EPIA MII12000	VIA EPIA PD10000	VIA EPIA MII6000E	MITX-845GVD	VIA EPIA TC10000
3DMark03 Build 340	9	5	N/A	78	5
3DMark05 1.0.0	N/A	N/A	N/A	N/A	N/A
PCMark04 1.2.0	835	719	409	3440	713
CPU	920	763	431	4551	756
Memory	436	393	272	3021	387***
Graphics	212	206	162	569	198
HDD	3847	3837	3853	4036*	3842
Halo					
800 x 600	N/A	N/A	N/A	18.07	N/A
1,024 x 768	N/A	N/A	N/A	18.21	N/A
1,280 x 1,024	N/A	N/A	N/A	18.16	N/A
Doom 3					
800 x 600	N/A	N/A	N/A	5.8**	N/A
1,024 x 768	N/A	N/A	N/A	3.4**	N/A
1,280 x 1,024	N/A	N/A	N/A	N/A	N/A

* Using Western Digital WD1200JB hard drive.

** At Low detail setting.

*** Using 256MB SODIMM.

TC10000's passive chipset heatsinks—but it does cut down on power consumption. We installed a 256MB Kingston PC2100 SODIMM for our benchmarking session. With the same processor and chipset of the PD10000, the only ground the TC10000 gave up in our tests may have been due to its 256MB of memory instead of 512MB.

Our TC10000 didn't have the optional 5.1-channel VT1616 codec, but it did have a SPDIF header for the stereo VT1612A audio chip. Other options missing from our board included LVDS support and a CardBus/CF slot like the ones that came with our MIIs. There was a PCI slot and an LPT pin header, but no floppy connector.

So why go to all this trouble sourcing oddball parts? The TC10000's forte is power-sensitive situations. And the freedom from the gangling bulk of a traditional power supply actually frees up the TC10000 to fit in tight spaces.

Beyond Mini

Embedded or not, mini-ITX motherboards can cost just as much as larger ATX board/processor combos that offer greater speed and more upgrade options. You're essentially paying for the form factor, not cutting-edge power and technologies. If even SFF mainboards are too big for the task you have in mind, well, you know who you are. Look for cases, power supplies, and accessories at www .logicsupply.com, www.mini-system.net, and elsewhere.

Of the other boards of interest to mini-ITX fans, such as VIA's SP and MS, the one that has all the lords a-leaping and all the maids a-milking is the EPIA N (www.viaembedded.com/product/epia_N_spec.jsp?motherboardId=221). We wish we could have bought one by press time. The first in the new 4.7 x 4.7-inch (12 x 12cm) nano-ITX form factor, the N series is also the first to come with VIA's new CN400 chipset with the familiar VT8237 desktop southbridge. The EPIA Ns require SODIMMs and may come with massive, fanless heatsinks. Oh, and did we mention SATA, six-channel sound, RAID, and MPEG-4 acceleration? This is a mighty mite, indeed. CPU

by Marty Sems

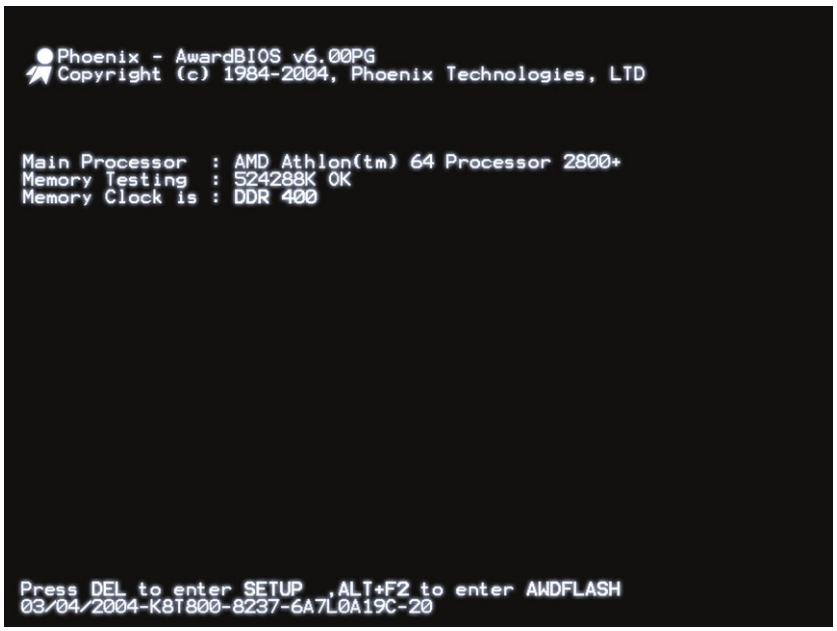
Feature Sets

One of these things is not like the others. C'mon, can you tell which one? Actually, apart from the potential horsepower that the ZIF Socket 478 bestows on the MITX-845GVD board, second from the right, the VIA boards keep up in feature lists. And then some, if you count Padlock encryption, TV-out, and the CardBus slots.

	VIA EPIA MII12000	VIA EPIA PD10000	VIA EPIA MII6000E	MITX-845GVD	VIA EPIA TC10000
Processor As Tested	1.2GHz C3 Nehemiah (C5P)	1GHz C3 Nehemiah	600MHz Eden ESP Samuel 2 (fanless)	3.06GHz P4, 533MHz/512MB L2	1GHz C3 Nehemiah
Socket Type	370-ball EBGA (embedded)	370-ball EBGA (embedded)	370-ball EBGA (embedded)	Socket 478 mPGA	370-ball EBGA (embedded)
Processor Support	VIA C3/Eden ESP	VIA C3/Eden ESP	VIA C3/Eden ESP	400/533MHz FSB Pentium 4/Celeron (Willamette, Northwood)	VIA C3/Eden ESP
Chipset	VIA CLE266/VT8235	VIA CLE266/VT8235	VIA CLE266/VT8235	Intel 82845GV/ICH4	VIA CLE266/VT8235
RAM Support	1GB max. DDR266	1GB max. DDR266	1GB max. DDR266	1GB max. DDR266/333	1GB max. DDR266
RAM Slots	1 (184-pin DIMM)	1 (184-pin DIMM)	1 (184-pin DIMM)	1 (184-pin DIMM)	1 (200-pin SODIMM)
Graphics Bus	integrated 8X AGP	integrated 8X AGP	integrated 8X AGP	integrated non-AGP	integrated 8X AGP
PCI Slots	1	1	1	1	1
SATA Ports	N/A	N/A	N/A	N/A	N/A
IDE	2 ATA/133; 1 floppy	2 ATA/133	2 ATA/133; 1 floppy	2 ATA/100 (1 is 44-pin), 1 floppy	2 ATA/133
USB Ports	4 USB 2.0 (2 integrated)	6 USB 2.0 (4 integrated)	4 USB 2.0 (2 integrated)	4 USB 2.0 (2 integrated)	6 USB 2.0 (2 integrated)
FireWire Ports	1 400Mbps (6-pin)	N/A	1 400Mbps (6-pin)	1 400Mbps (6-pin)	N/A
LAN	1 VIA Tahoe VT6103 10/100Mbps	2 VIA VT6105/ VT6103 10/100Mbps	1 VIA Tahoe VT6103 10/100Mbps	1 Realtek RTL8101 10/100Mbps	1 VIA Tahoe VT6103 10/100Mbps
Integrated Audio	5.1-channel VIA Vinyl Six-TRAC, coaxial SPDIF out	2-channel VIA VT1612A	5.1-channel VIA Vinyl Six-TRAC, coaxial SPDIF out	5.1-channel Realtek ALC650, coaxial SPDIF in/out	2-channel VIA VT1612A, SPDIF via header
Integrated Graphics	VIA/S3G Unichrome Pro CLE266; S-Video, VGA, composite out	VIA/S3G Unichrome Pro CLE266; VGA out	VIA/S3G Unichrome Pro CLE266; S-Video, VGA, composite out	Intel Extreme Graphics; VGA out	VIA/S3G Unichrome Pro CLE266; VGA out
Other Features	PadLock encryption; CardBus Type I/II slot	Dual LANs make this board suitable for firewall duty	CardBus Type I/II slot	Optional S-Video and composite video outputs	Requires 12V, 5A power transformer and SODIMM memory
Manufacturer	VIA	VIA	VIA	Qniq (probably)	VIA
URL	www.viaembedded.com	www.viaembedded.com	www.viaembedded.com	www.qniq.com.tw	www.viaembedded.com
Price	$197	$195	$182	$179	$239
Overall Rating	CPU CPU CPU CPU	CPU CPU CPU	CPU CPU CPU	CPU CPU CPU CPU	CPU CPU CPU

Bundles Of BIOS Update Utilities

We Update Five Motherboards In A Flash


Phoenix - AwardBIOS v6.00PG
Copyright (c) 1984-2004, Phoenix Technologies, LTD
Main Processor : AMD Athlon(tm) 64 Processor 2800+
Memory Testing : 524288K OK
Memory Clock is : DDR 400
Press DEL to enter SETUP ,ALT+F2 to enter AWDFLASH
03/04/2004-K8T800-8237-6A7L0A19C-20

The seemingly cryptic text running at the bottom of this POST screen shows that we were successful in updating this board's BIOS to v.20.

There are few things you can do to your computer that can produce such extreme effects as flashing the BIOS. On one hand, if your system isn't working properly, installing a new version of the BIOS can make a world of difference. On the other hand, if you don't flash the BIOS properly, your computer may be damaged to the point that it won't boot at all. The keys to a successful BIOS update are knowing when to flash the BIOS, knowing what version you need to download, and properly installing the BIOS.

A Time & Place For Everything

With so many worms and other serious threats stalking our systems, we've learned one lesson well: Update and update often. However, when it comes to updating the BIOS, you need to forget everything you've learned about the importance of frequent system updates. A bad BIOS update can potentially do enough damage that you need to ship the motherboard to the manufacturer for repair. It's essential that you only update the BIOS when your system has a problem that you are fairly certain a BIOS update can fix.

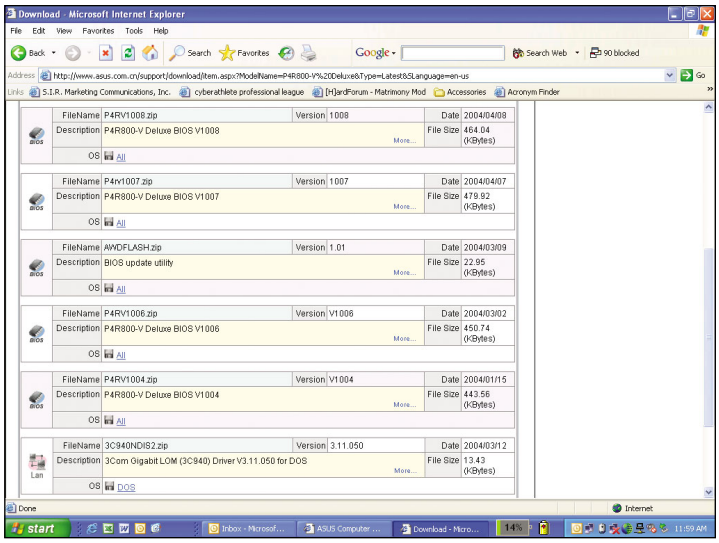
Motherboard manufacturers list downloadable BIOS updates on their Web sites' support pages. Most manufacturers provide details about the fixes they've incorporated into each update, as well as installation instructions. Unless you see an update that corrects an issue you've had with your system, there is probably more risk than benefit to updating the BIOS.

It is absolutely critical that you download the proper update for your motherboard. To do this, you must know two things: the model number (and sometimes also revision number) of your motherboard and the BIOS version currently installed on your motherboard. The procedures for locating the model number and BIOS version vary from manufacturer to manufacturer, so your best course of action is to consult the manufacturer's online documentation.

The means for flashing the BIOS also vary, not only from manufacturer to manufacturer but also from board to board. It is common for one manufacturer to offer several BIOS-update utilities, so it is important to know which utility your board requires. To demonstrate how varied BIOS-updating procedures are, we flashed the BIOSes of five motherboards.

ABIT's FlashMenu

We encountered a minor problem almost immediately when updating our ABIT board. The company's support site said we could find the model and version numbers of our board on a sticker on the last PCI slot. However, the sticker on this slot had a barcode and a string of numbers that was obviously not the model number. We did, however, find the desired sticker next to the processor. It indicated that our board was a KV8-MAX3 board and Version 1.2. Note that Version 1.2 refers to the version of the hardware (the motherboard) and not to the BIOS version.



ASUS' Web site conveniently lists all of the BIOS updates available for each of its motherboards on a separate downloads page.

To determine the current BIOS version, we checked the BIOS ID at the bottom of the POST screen; this screen scrolled by pretty quickly, so we had to press the PAUSE key to freeze the screen long enough to write down the full BIOS ID. The line with the BIOS ID read, "11/07/2003-K8T800-8237-6A7L0A19C-16." The beginning of the string told us that the installed BIOS was released on Nov. 7, 2003. The last set of numbers after the hyphen told us that BIOS v.16 was installed.

We looked up the KV8-MAX3 at ABIT's Downloads page and saw that the most recent updates are available through FlashMenu, a Windows-based utility that automatically locates, downloads, and installs the proper BIOS updates. FlashMenu does not work with all of ABIT's motherboards, but our board met its requirements, so we downloaded and installed FlashMenu 1.3.

When we ran FlashMenu from within Windows, a couple of warning messages about flashing the BIOS appeared. We read and accepted the messages to proceed. The FlashMenu screen displays the current BIOS version, which as you will recall, was v.16 for our system. We clicked One Click Live Update. A dialog box asked us to choose an FTP site for download. Two were listed; we chose ftp.abit.com and then waited for FlashMenu to download the update.

An on-screen message instructed us to close all other applications, which we did. FlashMenu also gave us the option to clear the CMOS data after the flash or leave it intact. We chose to clear the CMOS and then clicked the Yes button to start the BIOS update. In a few moments, a dialog box informed us that the BIOS was successfully updated and prompted us to restart the system.

After rebooting, Windows found several new pieces of hardware but reinstalled the drivers automatically. We restarted the system one more time and then pressed DELETE to check the BIOS settings. In the setup utility, we reconfigured settings that we'd lost. These included disabling the logo screen again and reconfiguring the boot disk priority. We pressed F10 to save the settings and exit the utility. When the POST screen appeared, we once again pressed PAUSE and saw "03/04/2004-K8T800-8237-6A7L0A19C-20" at the bottom of the screen, confirming that we'd flashed the BIOS from v.16 to v.20.

ASUS' AWDFLASH

Next, we flashed the BIOS of our ASUS P4R800-V Deluxe motherboard. According to ASUS' site, the most recent BIOS version for this motherboard was v.1008, released on April 8, 2004. ASUS has three flash utilities: AFLASH BIOS, AFUDOS BIOS, and AWDFLASH BIOS. The Web site lists the motherboard series that support each utility, but we didn't see our P4R800-V Deluxe listed. To learn which utility the motherboard used, we turned on the PC and checked the bottom of the logo screen, where ASUS prompted us to Press ALT+F2 To Enter AWDFLASH Utility, so we knew that our board used AWDFLASH.

We followed ASUS' instructions for flashing the BIOS using AWDFLASH. First, we created a boot disk. We inserted a floppy diskette and clicked Start, My Computer, the 3.5 Floppy (A:) icon, the File menu, and Format. In the resulting dialog box, we selected the Create An MS-DOS Startup Disk checkbox and clicked the Start button.

To see which BIOS version was installed, we inserted the ASUS installation CD. After the installation program launched, we clicked the Utilities tab and positioned the pointer over the Motherboard Information icon (the first of four icons in the upper-right corner of the window). On the left side of the window a list appeared, which included the BIOS Revision number. We closed the installation program and ejected the disc.

We returned to the ASUS Web site and downloaded the latest BIOS version for our motherboard. This file was in ZIP format, so we first saved it to the hard drive. Then we double-clicked the icon to extract the .AWD file. ASUS' AWDFLASH documentation instructed us to rename the file with a .BIN file extension, so we pressed F2 to highlight the filename and renamed it with the same name, replacing .AWD with .BIN. Then we copied the .BIN file to the bootable floppy diskette we made.

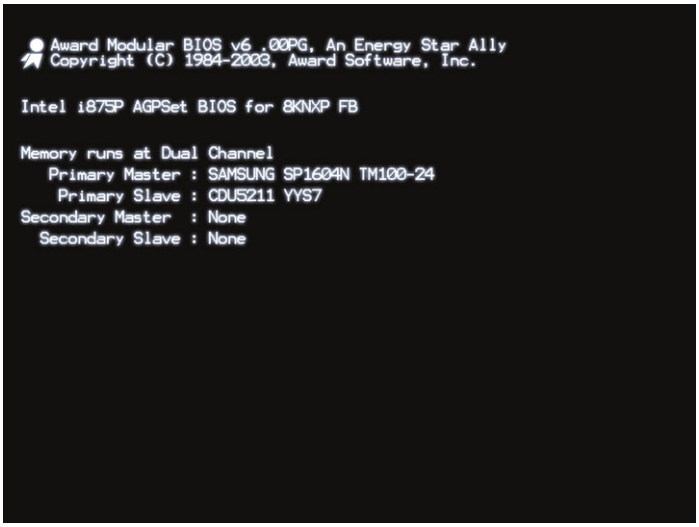
We closed all applications, left the diskette in the drive, and restarted the computer. When the logo screen appeared, we pressed ALT-F2 to enter the AWDFLASH utility. It found the BIOS update on the diskette and began the update automatically. As AWDFLASH updated the BIOS, we heard a series of beeps, and then

Windows loaded. We were careful not to interfere with the system at all until after the BIOS update was complete and Windows had finished loading.

To confirm that the update was installed successfully, we inserted the ASUS installation disc in the drive again and followed the same procedures as last time to check the BIOS Revision number. This confirmed that our board was now running v.1008, which matched the version number of the update we downloaded.

GIGABYTE's Q-Flash

Our motherboard was compatible with GIGABYTE's Q-Flash utility, which lets you update the BIOS from within the BIOS Setup menu. To see which BIOS version was installed, we booted the computer and looked in the upper-left corner of the POST screen. By default, though, the POST screen is covered by the logo screen, so we pressed DELETE to enter the setup utility and disabled the logo screen. After saving the changes and exiting the setup utility, we pressed PAUSE when the POST screen appeared. In the upper-left corner, we saw "Intel i875P AGPSet BIOS for 8KNXP FB." At the end of this line, the 8KNXP indicated our motherboard, and FB was our BIOS version.


Award Modular BIOS v6 .00PG, An Energy Star Ally
Copyright (C) 1984-2003, Award Software, Inc.
Intel i875P AGPSet BIOS for 8KNXP FB
Memory runs at Dual Channel
Primary Master : SAMSUNG SP1604N TM100-24
Primary Slave : CDU5211 YYS7
Secondary Master : None
Secondary Slave : None

The line "Intel i875P AGPSet BIOS for 8KNXP FB" shows us that BIOS FB is currently installed.

We went to GIGABYTE's BIOS download page and used the drop-down menus to select the 8KNXP motherboard. However, two boards were listed, the 8KNXP and the 8KNXP (Rev. 2). It was easy to tell which we needed, however. The 8KNXP had BIOS versions with numbers (such as F3 and F4), whereas the Rev. 2 board had BIOS versions with all letters (such as FB and FD). Because our board also used all letters, we knew it was an 8KNXP Revision 2 board.

GIGABYTE encourages installing BIOS updates in small increments rather than jumping ahead too many BIOS versions at a time. Because our system had BIOS FB, we first updated to BIOS FG and then from BIOS FG to BIOS FJ.

The files we downloaded were packed in a self-extracting EXE file, so we double-clicked the downloaded file and then located the file 8KNXP2.FG, which is a combination of the model number and BIOS version. We copied this file to a diskette and then copied the other file, 8KNXP2.FJ to the same diskette. (Q-Flash lets you copy more than one file to disk at a time.)

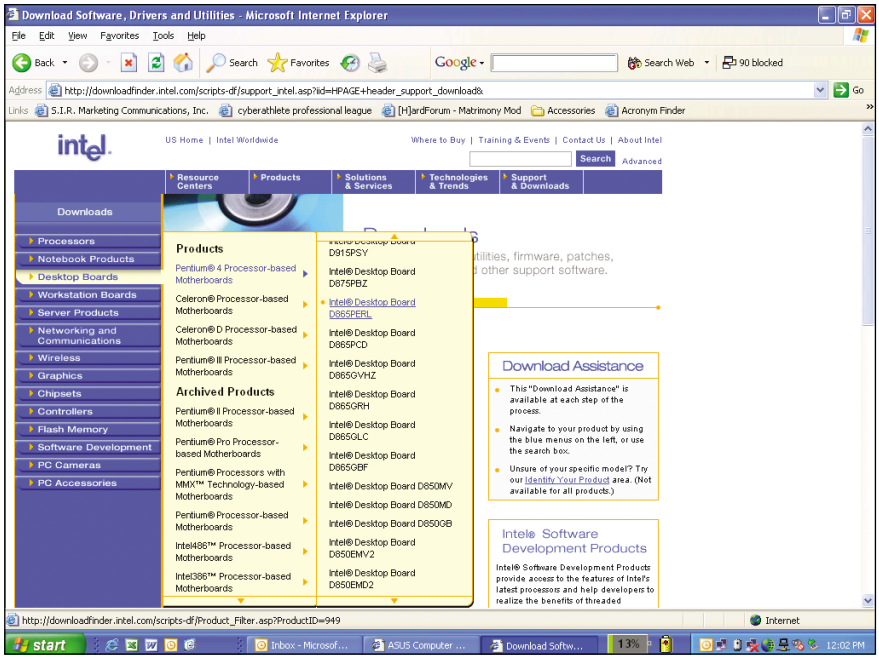
After restarting our PC, we pressed DELETE to enter the setup utility and pressed F8 to access the Dual BIOS/Q-Flash menu. Dual BIOS is a feature in which GIGABYTE installs two system BIOSes on the motherboard, a main BIOS and a backup BIOS. The Dual-BIOS menu consumed the top two-thirds of the screen, and the Q-Flash menu appeared in the bottom third of the screen. We inserted the diskette with the downloaded BIOS files, selected Update Main BIOS From Floppy, and pressed ENTER. Q-Flash informed us that the floppy contained two files, 8KNXP2.FG and 8KNXP2.FJ. We selected the first update and pressed ENTER. A series of messages appeared on screen as Q-Flash worked. We followed all on-screen prompts and waited until "!! Copy BIOS completed - Pass !!" appeared on-screen. Then we pressed a key to continue and F10 to turn off the system. When we rebooted, we checked the POST screen to verify that BIOS FG was installed (it was), then rebooted again, entered the setup utility, pressed F8 to enter the Dual BIOS/Q-Flash menu, and installed the FJ update, using the same procedure as we did for FG.

Intel's Express BIOS

Our Intel motherboard used the user-friendly utility Intel Express BIOS, which lets you update the BIOS from within Windows. To determine which BIOS version was installed, we started the PC and pressed ESC to skip the logo screen. Then we pressed F2 to enter the setup utility.

A system's BIOS version appears under the Main tab of the setup utility. In our case, the line read "BIOS Version RL86510A.86A.0075.P15." In the BIOS Version string, the first two sets of numbers are code for the mobo model. The last two sets of numbers are the BIOS identifier code. In other words, our system was running Version P15, Build 0075.

We exited the setup utility, and after Windows loaded, we went to Intel's Web site and looked for the latest BIOS downloads for our motherboard. The most recent version was RL86510A.86A.0085.P19. We downloaded the Intel Express BIOS Update version of P19 because Intel encourages Windows XP users to use Intel Express BIOS rather than the DOS-based iFLASH. After downloading the file to our hard drive, we closed all applications and double-clicked the RL86510A.86A.0085.P19.EB.EXE icon.



It is easy to locate your motherboard's download page at Intel's Web site.

A wizard appeared on-screen and guided us through the update. After we accepted Intel's EULA, the wizard stated that Express BIOS was ready to update the BIOS. We clicked the Finish button to proceed, and Windows automatically rebooted. We heard a series of beeps coming from the motherboard as it installed the new BIOS version. After Windows loaded, a dialog box appeared and stated that the update was successful. We clicked the OK button.

Finally, we restarted the PC to verify that the update was successful. At the Intel logo screen, we pressed ESC and then F2 to enter the setup utility. Under the Main tab, we saw that the BIOS Version was now RL86510A.86A.0085 .P19, indicating a successful update.

MSI's AMI FLASH

MSI provides two sets of update instructions on its site, one for FAT systems and another for non-FAT systems. Our test system's hard drive was formatted in NTFS, so we followed the non-FAT instructions.

First, we located the model and revision numbers (MS-6728 Ver. 2) of our board between the PCI slots. We checked the installed BIOS version by pressing PAUSE when the POST screen appeared at startup. (The logo screen initially covered the POST screen, so we used the BIOS setup utility to disable the logo screen.) The BIOS version appeared on the upper-left corner of the POST screen. In our case, A6728IMS V3.5 020504 indicates that we have the MS-6728 motherboard (865PE Neo2-S) with BIOS 3.5 installed.

At MSI's Web site, we found the BIOS download for our model number (MS-6728) and version number (Ver. 2). The most recent release for our board was BIOS 3.9, released on September 16, 2004. According to the download page, this update uses the AMI BIOS utility. After downloading the file, which is in ZIP format, we extracted it to a blank, formatted diskette. You will remember that ASUS' update required us to copy the file to a boot floppy, but MSI's procedure is different. It is important that the MSI BIOS file is on an otherwise blank disk and not on the boot diskette. After extracting the ZIP file to floppy, we saw four files on the diskette. One of these was A6728IMS.390 (the update), and one was Adsfi711.exe (the flash utility).

AMI BIOS requires a Windows 98/Me boot disk. MSI warns that any other boot disk, including a WinXP boot disk will not work, so we booted from a Win98 boot diskette and, when prompted, chose to Start Without CD-ROM Support. A warning message confirmed what we already knew—that there was no valid FAT or FAT32 partition on our system. Finally, an on-screen message stated, "Diagnostic tools were successfully loaded to drive C."

The last two words of that message were significant because they let us know what drive letter the boot floppy designated for the RAMDRIVE, a virtual disk from which we will run our system during the BIOS update.

An A> prompt appeared, and we replaced the boot diskette with the floppy diskette that contained the downloaded BIOS update files. We then typed **copy Adsfi711.exe c:** to copy the AMI flash utility from the floppy to the virtual drive. At the next prompt, we typed **copy A6728IMS.390 c:** to copy the BIOS update file to the virtual drive.

Finally, we moved from the A: directory to the virtual drive's directory and typed **Adsfi711 A6728IMS.390**, which instructed the system to load the file A6728IMS.390 in the program Adsfi711 (AMI FLASH). When the update was complete, a confirmation appeared. We ejected the diskette and restarted the system. The upper-left corner of the POST screen now displayed A6728IMS V3.9 091604, indicating a successful update.

Bunches Of BIOSes

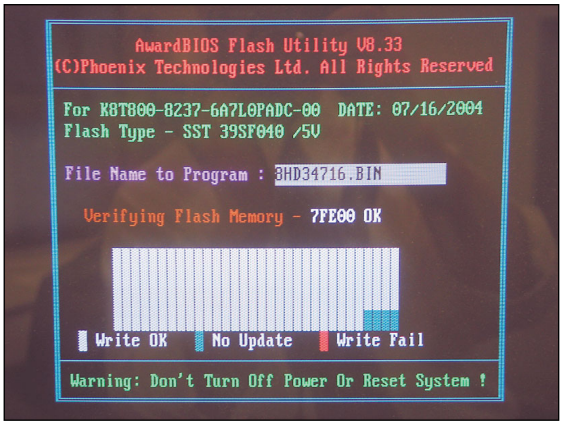
We looked at the update procedures for five motherboards from five manufacturers, and the procedures varied quite a bit from mobo to mobo. If we discussed updating a board you have in your system, you now have a quick, step-by-step guide to installing a new BIOS. If not, we've at least established how important it is to know what motherboard and BIOS you're running and what version you need so that you can use the appropriate flash utility from your mobo's manufacturer. For more information about flashing the BIOS, see "The BIOS Factor" on page 142. CPU

by Kylee Dickey

The BIOS Factor

Gauging A BIOS Update's Impact

Nothing in the computer industry ever leaves the factory perfect, which is why most software and hardware products give you some way to update them. Windows XP and antivirus programs would be seriously vulnerable if you couldn't download patches and new virus definitions for them. Video cards can get speed boosts and new feature support via the latest drivers, whereas optical drives can sometimes reach higher writing speeds and support more brands of blank discs after firmware updates.


AwardBIOS Flash Utility V8.33
(C)Phoenix Technologies Ltd. All Rights Reserved
For K8T800-8237-6A7L0PADC-00 DATE: 07/16/2004
Flash Type - SST 39SF040 /5V
File Name to Program : 3HD34716.BIN
Verifying Flash Memory - 7FE00 OK
Write OK
No Update
Write Fail
Warning: Don't Turn Off Power Or Reset System !

We prefer to do BIOS updates from within Windows, as we can while using ASUS' motherboard utilities. EPoX didn't recommend that we use any such method to update its board's BIOS, so here we are using a floppy disk and a preboot utility.

New chipset drivers aside, the primary way to bring your motherboard up-to-date is to update its BIOS. Essentially, software stored on a nonvolatile memory chip often called a CMOS, the BIOS provides a foundation of communication between the devices connected to the motherboard and the OS, such as Windows or Linux. Because it plays this role, overwriting the BIOS with a new version can sometimes fix problems, such as Y2K issues, or accommodate new technologies, such as EIDE hard drives larger than 137GB.

Declaring Our BIOS

In this article, we'll walk you through the method we used to update the BIOS on our EPoX EP-8HDA3+ motherboard. As a bonus, we benchmarked it before and after two updates to see how they affected performance scores.

Time was, the only way you could update a BIOS chip was to replace it. Of course, prerelease product testing was more thorough then, and hardware upgrade options were few. Today, motherboard manufacturers offer BIOS updates to fix bugs, activate latent features such as Hyper-Threading, and support new CPUs.

Because the BIOS chip is programmable like flash memory, updating it is also called "flashing" the BIOS. Most, if not all, updates are cumulative; when you download the latest BIOS version for your mainboard, you're getting all the fixes and tweaks of the previous updates, too.

It's not hard to flash your BIOS, but it does require you to follow the provided instructions to the letter. You'll find step-by-step directions on the manufacturer's site or, in the case of our EPoX board, as Readme.txt files packed into each update's self-extracting archive file.

You'll need to use the motherboard manufacturer's specific update utility and also to make sure you use the right version of the utility for the particular BIOS update. The proper version should be available at the manufacturer's Web site if it doesn't come with the update itself. Some BIOS-flashing utilities can run in Windows; you may have to enter others by pressing a designated key after rebooting your system. Still others must be installed on a bootable floppy disk and run from there.

Just like flashing your birthday suit in a public place, flashing a BIOS carries some risk. If anything goes wrong—say something disturbs the PC or cuts power to it before the update is finished—it could make your PC unbootable. EPoX and other manufacturers say that if your system is working fine with its existing BIOS version, there's no need to update it. In other words, if it ain't broke, don't fix it. The cure is sometimes harsher than the disease.

Soup To Nuts

We didn't have any monitoring utilities on our Windows XP Professional system that could tell us the current BIOS version, so we tried the trick that should work for nearly any mobo. We restarted the PC and then kept an eye on the top and bottom of the screen. Normally you'll have a few seconds to see the BIOS version and write it down. It's usually a date or a string of alphanumeric characters, such as V1013.

Don't write down the first BIOS version that appears, as it's usually the video card's BIOS. Wait until you see the words "Phoenix," "Award," or "AMIBIOS" next to the version number. If you miss the BIOS version the first time, wait until Windows loads and then reboot again. Try pressing your keyboard's PAUSE key, which may freeze the screen. Our version turned out to be 12/2/03.

In most cases, the only source you should trust for BIOS updates for your motherboard is the manufacturer. On the other hand, if you have an old board whose maker went out of business, you may have no other choice but to trust a third-party site that offers BIOSes and drivers for obsolete hardware.

EPoX is still alive and kicking, so we went to its U.S. Web site and found its

Achtung, Baby

Never disturb the PC during a BIOS update. If the update fails and your system won't boot thereafter, check the users manual for instructions on clearing the CMOS. It usually involves unplugging the computer and then moving a jumper for a few seconds or more. ▲

download section (www.EPoX.com/USA/downloads.asp). Here, we selected BIOS Updates under File Type and our board's model number, EP-8HDA3+, under Model. We clicked OK and found four BIOS versions for our mainboard. Three of them were newer than the BIOS we had.

You should download the newest version for your motherboard, as well as a copy of the BIOS your board currently has in case something goes wrong. We recommend preparing a DOS diskette with the existing BIOS version on it and a suitable flashing utility in case you need to do an emergency rescue. Your mobo's users manual, installation CD, or its manufacturer's Web site should tell you how.

For illustrative purposes, we downloaded the second-to-most recent BIOS version (5/12/04), as well as the latest edition (7/16/04) and a copy of our existing BIOS (12/2/03). We used the two newer updates so we could benchmark after each flashing and see if either file made our PC appreciably faster or slower. You should only install the latest BIOS update for your board, unless you have reason not to trust it or you want to benchmark each version, as we did.

Update prepping. Next, we had to figure out which utility our first BIOS update needed to use to install itself. EPoX's documentation said that the update file itself would tell us which utility to use, so we double-clicked the compressed 5/12/04 update file, called 8HD34512.exe.

The 5/12/04 file opened a warning screen and then prompted us to insert a blank diskette on which to install the BIOS update. We did so and then clicked Unzip. After the floppy drive stopped whirring, we clicked OK and Close. Next, we selected Start, My Computer, and the A: drive to see the new files on the floppy. As it turned out, one of the files extracted to the BIOS update diskette was the flash utility that update required.

We double-clicked Readme.txt for further instructions. This text file offered two flashing methods, as well as other info, so we printed it. One of the flashing methods required us to make a separate bootable disk, so we put a fresh floppy in the drive. We right-clicked Start and selected Explore and then right-clicked the A: drive and chose Format. We selected Create An MS-DOS Startup Disk and then Start and OK. When the formatting finished, we removed this boot disk and set it aside. Finally, we made a third BIOS update diskette using the version our board currently had, 12/2/03, in case we needed to revert the PC back to it later.

Moment of truth. Most updates such as this will cause your BIOS settings to drop back to defaults, so you'll need to write down its current settings if you're not familiar with them. Reboot your PC and press whichever key is indicated to enter the Setup/CMOS/BIOS, such as DELETE. Use the keys in the on-screen legend, such as the arrow and PAGE UP/DOWN keys, to get around. Exit without saving any changes.

Finally, we could flash the BIOS. Following the directions in our 5/12/04 update diskette's Readme file, we rebooted the system and pressed ALT-F2 when prompted. We inserted the BIOS update diskette and pressed ENTER as directed. The Award flash utility updated the BIOS without any further help from us and then restarted the system.

We glimpsed the new BIOS version's date as the PC rebooted, so we knew that the procedure had worked. Afterward, we went back into the Setup utility and reset our BIOS settings to their preflash configuration. This time, we saved our changes and exited.

The Updated Life

As we expected, neither of our BIOS updates affected our PC's speed very much. However, we can rest assured that our motherboard is current on all its shots, so to speak. It's also ready to tackle the latest 754-pin AMD processors, should we decide to upgrade. CPU

by Marty Sems

BIOS Benchmarks

Some BIOS updates may change your computer's speed a bit, but these two didn't. Our test PC had an EPoX EP-8HDA3+ motherboard with VIA's K8T800/VT8237 chipset, a 754-pin Athlon 64 2800+, 512MB of PC4400 DDR (OCZ Gold Edition), a Gainward GeForce FX 5900XT 128MB AGP 8X video card with NVIDIA's 61.77 drivers, a Maxtor 6Y080M0 80GB 7,200rpm SATA hard drive with an 8MB cache, and Windows XP Professional with Service Pack 2 and all updates. Other resident processes included WinXP's firewall and Trend Micro PC-cillin 2002. Doom 3 was set to High Quality detail.

	BIOS 12-2-03	BIOS 5-12-04	BIOS 7-16-04
BIOS version notes	Our board's initial BIOS version	Update AMD processor power and thermal data table (Cool&Quiet); patch processor problem	Update processor microcode; support Sempron; correct hardware monitor bug
3DMark03 Build 340	**5152**	**5151**	**5145**
PCMark04 1.2.0	**3597**	**3583**	**3598**
CPU	3377	3352	3357
Memory	3387	3383	3383
Graphics	4261	4259	4255
HDD	4415	4379	4332
Halo			
800 x 600	40.35fps	39.99fps	40.18fps
1,024 x 768	37.99fps	38.07fps	37.95fps
1,280 x 1,024	30.14fps	30.08fps	30.05fps
Doom 3			
800 x 600	41fps	43fps	39.9fps
1,024 x 768	32.3fps	32.4fps	32.3fps
1,280 x 1,024	23.5fps	22.7fps	23.5fps

The Big List

Is Your BIOS Behind The Times?

In our quest to make your life easier (the part that pertains to computers, anyway), we've compiled a list of current desktop PC mobos from major manufacturers that shows each board's most up-to-date BIOS version, where to find it, and whether a flash utility download is available. All listings are current as of this writing, but of course versions and availability are subject to change. (Unavailable information appears as "N/A.") For info on phased-out boards, check your manufacturer's Web site. And for several times as many listings as are shown here (including lists for 21 mobo manufacturers) complete with hyperlinks to each board's downloads page, please visit www.cpumag.com/biosupdates.

ASUS: (www.asus.com/support/download/download.aspx)

CPU	Socket	Motherboard	Chipset	BIOS	Flash Utility
Intel	LGA 775	P5AD2 Premium	Intel 925X	1005	YES
		P5AD2 Deluxe	Intel 925X	1002	YES
		P5GD2 Premium	Intel 915P	1005	YES
		P5GD2 Deluxe	Intel 915P	1003	YES
		P5GD1	Intel 915P	1004	YES
		P5GDC Deluxe	Intel 915P	1002	YES
		P5GD2	Intel 915P	1001	YES
		P5GDC-V Deluxe	Intel 915G	1003	YES
		P5GD1-VM	Intel 915G	1004	YES
	Socket 478	P4R800-VM	ATI Radeon 9100 IGP	1005	YES
		P4R800-V Deluxe	ATI Radeon 9100 IGP	1008	YES
		P4C800-E Deluxe	Intel 875P	1002	YES
		P4C800 Deluxe	Intel 875P	1017	YES
		P4P800-E Deluxe	Intel 865PE	1002	YES
		P4P800 SE	Intel 865PE	1005	YES
		P4P800-VM	Intel 865G	1012	YES
		P4G800-V	Intel 865G	1008	YES
		P4P800-MX	Intel 865GV	1002	YES
		P4P800S	Intel 848P	1006	YES
		P4PE2-X	Intel 845PE	1003	YES
		P4GE-V	Intel 845GE	1004	YES
		P4BGV-MX	Intel 845GV	1014	YES
		P4BP-MX	Intel 845GV	1017	YES
		P4S800-MX	SiS 661FX	1009	YES
		P4S800D-E Deluxe	SiS 655TX	1006	YES
		P4SP-MX	SiS 651	1003	YES
		P4S800	SiS 648FX	1009	YES
		P4S8X-X	SiS 648	1004	YES
		P4V8X-X	VIA P4X533	1008	YES
		P4VP-MX	VIA P4M266A	1007	YES
AMD	Socket A	A7N8X-E Deluxe	NVIDIA nForce2-ST	1012	YES
		A7N8X	NVIDIA nForce2-S	1010	YES
		A7N8X-X	NVIDIA nForce2-400	1010	YES
		A7N8X-VM/400	NVIDIA nForce2 IGP	1003	YES
		A7V880	VIA KT880	1004	YES
		A7V600	VIA KT600	1007	YES
		A7V600-X	VIA KT600	1005	YES
		A7V8X-X	VIA KT400	1012	YES
		A7V8X-MX SE	VIA KM400	1005	YES
		A7V400-MX	VIA KM400A	1003	YES
	Socket 754	K8V SE Deluxe	VIA K8T800	1004	YES
		K8V	VIA K8T800	1004	YES
		K8N-E Deluxe	NVIDIA nForce3 Pro 250 GB	1004	YES
	Socket 939	A8V Deluxe	VIA K8T 800 Pro	1006	YES
	Socket 940	SK8V	VIA K8T800	1002	YES
		SK8N	NVIDIA nForce3 Pro 150	1007	YES

DFI: (www.dfi.com.tw/Support/Download/download_us.jsp?CATEGORY_TYPE=MB&INDEX_TYPE=MB&SITE=NA)

CPU	Socket	Motherboard	Chipset	BIOS	Flash Utility
Intel	LGA 775	LANPARTY UT 915P-T12	Intel 915P	915LD 72A.zip	N/A
	Socket 478	648FX-AL	SiS 648FX	648FXAL 1128.zip	N/A
		648FX-ALE	SiS 648FX	648FXALE 11281.zip	N/A
		661FX-MLV	SiS 661FX	661FXMLVE 1230.zip	N/A
		661FX-MLV rev. C	SiS 661FX	661FXMLV 0803.zip	N/A
		661FX-MLVE	SiS 661FX	661FXMLVE 1230.zip	N/A
		845GV-MLV	Intel 845GV	845GVMLV 0918.zip	N/A
		845PE-ML	Intel 845PE	845GVMLV 4M0420.zip	N/A
		848P-AL	Intel 848P	848PAAL 1009.zip	N/A
		865GV-MLV	Intel 865GV	865GVMLV 1208.zip	N/A
		865GV-MLV rev. C	Intel 865GV	865GVMLV 0213.zip	N/A
		865PE INFINITY	Intel 865PE	865PEInfinity 409.zip	N/A
		865PE INFINITY rev. B	Intel 865PE	865PEINF 4M0409.zip	N/A
		865PE-ML	Intel 865PE	865PEML 1215.zip	N/A
		865PE-ML rev. C	Intel 865PE	865PEML 0213.zip	N/A
		875 INFINITY	Intel 875P	875ID409. exe	N/A
		875P INFINITY	Intel 875P	875PINF 0722.zip	N/A
		LANPARTY 865PE	Intel 865PE	LP865PE 0409.zip	N/A
		LANPARTY 865PE rev. B	Intel 865PE	LP865PE 0409.zip	N/A
		LANPARTY PRO875	Intel 875P	875I37221. bin	N/A
		LANPARTY PRO875B	Intel 875P	875BD409. exe	N/A
		LANPARTY PRO875B rev. B	Intel 875P	LPPRO875B 0409.zip	N/A
		NB30-BC	Intel 845GL	NB3004072. zip	N/A
		NB30-BL	Intel 845GL	NB3004073. zip	N/A
		NB33-BC	Intel 845D	N/A	N/A
		NB33-BC/E	Intel 845E	NB33BCLE 0411.zip	N/A
		NB35-BC	Intel 845G	NB351213. zip	N/A
		NB35-TC	Intel 845GE	NB35TA29. zip	N/A
		NB35-TL	Intel 845GE	NB351230. zip	N/A

GIGABYTE: (http://www.gigabyte.com/Motherboard/Support/BIOS/BIOS_LIst.htm)

CPU	Socket	Motherboard	Chipset	BIOS	Flash Utility
Intel	LGA 775	GA-8IP775-G	Intel 865P	F2	YES
		GA-8IPE775 Pro	Intel 865PE	F2	YES
		GA-8IPE775-G	Intel 865PE	N/A	N/A
		GA-8I915G-MF	Intel 915G	F3	YES
		GA-8I915G Pro	Intel 915G	F5	YES
		GA-8I915P-D Pro	Intel 915P	F3	YES
		GA-8I915P-G	Intel 915P	F3	YES
		GA-8I915P-MF	Intel 915P	F2	YES
		GA-8I915P Duo	Intel 915P	F2	YES
		GA-8I915P Duo Pro	Intel 915P	F1	YES
		GA-8I915P Pro	Intel 915P	F3	YES
		GA-8I915P Duo-A	Intel 915P	N/A	N/A
		GA-8I915P Duo Pro-A	Intel 915P	N/A	N/A
		GA-8GPNXP Duo	Intel 915P	F3	YES
		GA-8ANXP-D	Intel 925X	F3	YES
	Socket 478	GA-686SLX	ALi Aladdin	2.0	N/A
		GA-6OMM7E	ALi Aladdin	F9	N/A
		GA-586ATX2	ALi Aladdin	2.3	N/A
		GA-586ATX3	ALi Aladdin	4.0	N/A
		GA-586ATX4	ALi Aladdin	2.7	N/A
		GA-8TRS300M	ATI 9100IGP	F7b (Beta)	YES
		GA-8TRS350MT	ATI 9100IGP	F5	YES
		GA-8ID533 (Rev 1.0)	Intel 845	F4	YES
		GA-8IRXP	Intel 845	F9	YES
		GA-8IR533	Intel 845	F5	YES
		GA-8IRE	Intel 845	F4a (Beta)	YES
		GA-8IRM	Intel 845	F8	YES
		GA-8IRX	Intel 845	F10	YES
		GA-8IDML	Intel 845	F9	YES
		GA-8IDML-C	Intel 845	F9	YES
		GA-8IDX	Intel 845	F10	YES
		GA-8IDXH	Intel 845	F10	YES
		GA-8IRML	Intel 845	F8	YES
		GA-8ID533 (Rev 1.1)	Intel 845	F4	YES
		GA-8ID	Intel 845	F1	YES
		GA-8IR2003 (Rev 2.0)	Intel 845	F5	YES
		GA-8ID2003	Intel 845	F2	YES
		GA-8IE800	Intel 845E	F5a (Beta)	YES
		GA-8IE2004P-L	Intel 845E	F5	YES
		GA-8IE2004P	Intel 845E	F5	YES
		GA-8IE2004-L	Intel 845E	F3	YES
		GA-8IE2004	Intel 845E	F3	YES
		GA-8IE533	Intel 845E	F6b (Beta)	YES
		GA-8IEMK	Intel 845E	F3	YES
		GA-8IEXP (Rev 1.2)	Intel 845E	F9	YES
		GA-8IE	Intel 845E	F7	YES
		GA-8IEML-T	Intel 845E	F5a (Beta)	YES
		GA-8IEX (Rev 2.0)	Intel 845E	F8	YES

Intel:

(downloadfinder.intel.com)

CPU	Socket	Motherboard	Chipset	BIOS Utility	Flash
Intel	LGA 775	D925XBC	Intel 925X	CV92510A.86A.0249	YES
		D925XCV	Intel 925X	CV92510A.86A.0249	YES
		D915GEV	Intel 915G	EV91510A.86A.0260	YES
		D915GUX	Intel 915G	EV91510A.86A.0260	YES
		D915GAV	Intel 915G	EV91510A.86A.0234	YES
		D915GAG	Intel 915G	EV91510A.86A.0234	YES
		D915PBL	Intel 915P	CY91510A.86A.0014	YES
		D915PCY	Intel 915P	CY91510A.86A.0014	YES
		D915PCM	Intel 915P	CY91510A.86A.0014	YES
		D915PGN	Intel 915P	CY91510A.86A.0022	YES
		D915PSY	Intel 915P	CY91510A.86A.0014	YES
	Socket 478	D875PBZ	Intel 875P	BZ87510A.86A.0106.P27	YES
		D865GRH	Intel 865G	N/A	N/A
		D865PERL	Intel 865PE	RL86510A.86A.0085.P19	YES
		D865GBF	Intel 865G	BF86510A.86A.0065.P19	YES
		D865GLC	Intel 865G	BF86510A.86A.0065.P19	YES
		D848PMB	Intel 848P	N/A	N/A
		D845PESV	Intel 845PE	SV84510A.86A.0017.P09	YES
		D845GEBV2	Intel 845GE	RG84510A.86A.0033.P17	YES
		D845GERG2	Intel 845GE	N/A	N/A
		D845PEMY	Intel 845PE	FN84510A.86A.0008.P02	YES
		D845GVFN	Intel 845GV	FN84510A.86A.0008.P02	YES
		D865GVHZ	Intel 865GV	BF86510A.86A.0065.P19	YES
		D865PCD	Intel 865P	N/A	N/A
		D845GVSR	Intel 845GV	N/A	N/A
		D845EPI	Intel 845E	N/A	N/A

MSI:

(http://www.shuttle.com/hq/support/download/download2.asp)

CPU	Socket	Motherboard	Chipset	BIOS	Flash Utility
Intel	LGA 775	925X Neo Platinum-54g	Intel 925X	v. 1.0	N/A
		915P Neo2 Platinum	Intel 915P	v. 3.0	N/A
		915P Combo-FR	Intel 915P	v. 1.3	N/A
		915G Combo-FR	Intel 915G	v. 1.3	N/A
		915GM-FR	Intel 915G	v. 1.0	N/A
	Socket 478	875P Neo-FISR	Intel 875P	v. 3.4	N/A
		865PE Neo2-PFS (Platinum Edition)	Intel 865PE	v. 3.8	N/A
		865PE Neo2-PFISR	Intel 865PE	v. 3.8	N/A
		865PE Neo2-V	Intel 865PE	v. 2.3	N/A
		865PE Neo2-PLS	Intel 865PE	v. 2.3	N/A
		865PE Neo2-LS	Intel 865PE	v. 2.3	N/A
		865G Neo2-PLS	Intel 865G	v. 3.5	N/A
		865GM2-LS	Intel 865G	v. 5.3	N/A
		865GVM2-LS	Intel 865GV	v. 1.1	N/A
		848P Neo-LS	Intel 848P	v. 1.8	N/A
		848P Neo-V	Intel 848P	v. 5.4	N/A
		845PE Neo-L	Intel 845PE	v. 7.3	N/A
		845GVM-V	Intel 845GV	v. 1.4	N/A
		661FM-L	SiS 661FX	v. 3.6	N/A
		651M-L	SiS 651	v. 1.1	N/A
		651M-V	SiS 651	v. 6.0	N/A
		PT880 Neo-LSR	VIA PT880	v. 1.8	N/A
		PX8 Neo-V	VIA P4X533	N/A	N/A
		P4MAM-V	VIA P4M266A	v. 2.4	N/A
AMD	Socket A	K7N2 Delta2 Platinum	NVIDIA nForce2 Ultra 400	v. B1	N/A
		K7N2 Delta-ILSR	NVIDIA nForce2 Ultra 400	v. 7.8	N/A
		K7N2 Delta-L	NVIDIA nForce2 Ultra 400	v. 5.8	N/A
		K7N2GM2-LSR	NVIDIA nForce2 IGP	v. 3.2	N/A
		K7N2GM-L	NVIDIA nForce2 IGP	v. 1.6	N/A
		KT880 Delta-FSR	VIA KT880	v. 1.6	N/A
		KT6V-LSR	VIA KT600	v. 1.7	N/A
		KT4AV-L	VIA KT400A	v. 5.3	N/A
		KM4AM-L	VIA KM400A	v. 3.5	N/A
		KM4AM-V	VIA KM400A	v. 1.2	N/A
		KM4M-L	VIA KM400	v. 1.6	N/A
		KM4M-V	VIA KM400	v. 1.2	N/A

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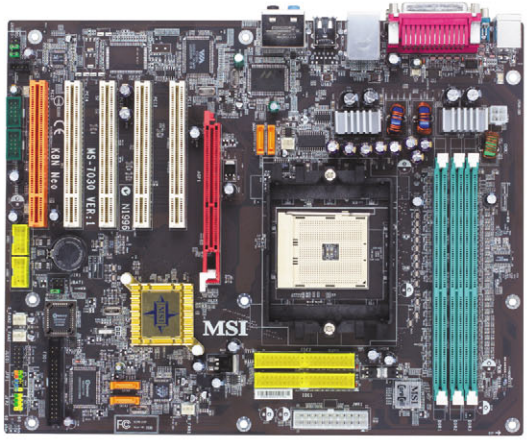

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- PCStats.com

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Also Available Athlon 64 Models:

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K8MM-ILSR

K8T Neo-FSR

K8T Neo-FIS2R

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Tech White Paper:

The Boot Process

A Peek Behind The Curtain

The amount of time that passes between turning on a computer and seeing the Windows Desktop has confounded computer users since the first version of the operating system was released, but most people aren't aware of the complexities that transpire in that period. PCs are so commonplace that we take them for granted, and it is easy to forget how many complicated pieces of hardware must seamlessly cooperate to perform even the most mundane computing task. So, while you're waiting for your PC to seemingly stumble through its morning wakeup ritual, why not take a closer look at the complex dance between hardware and software that takes place as the fans spin up and the hard drive chatters away?

Although the basics of the boot process don't vary much from computer to computer, the specifics do, depending on the type of BIOS that is installed, the OS you use, and other factors. For the purposes of this article, we'll assume that the PC has Windows XP installed and uses the popular AMIBIOS from American Megatrends (www.ami.com).

Component Crash Course

Before we detail the step-by-step boot process for a typical WinXP PC, it is important to discuss the components involved in that process, which include the BIOS, CMOS (complementary metal-oxide semiconductor), MBR (master boot record), and WinXP Registry.

The BIOS is a critical component of a PC because it determines many things, including what operating systems, CPUs, bus technologies, and many other capabilities the PC can support. BIOS data, called firmware, is stored on a memory chip that is soldered to the computer's motherboard, and can be updated through a process called flashing.

The CMOS is another memory chip, powered by a watch battery that lets it maintain the current time even when you power down your system. If Windows keeps booting with the incorrect time, it may be a sign that you need to replace the battery and reset the time via the BIOS settings interface. The CMOS also keeps a list of the order in which the BIOS searches for boot drives to boot your computer. For example, it may look for a bootable CD-ROM first, then look for a bootable floppy diskette, and then look for a bootable hard drive if the previous two drives do not contain any bootable media.

The MBR is located at the very beginning of a hard drive (cylinder 0, head 0, sector 1), and is the first bit of data the computer accesses from the hard drive each time the system boots up. The MBR contains a Master Partition Table, listing the number and size of partitions contained on the hard drive, and it also contains the Master Boot Code, a program that begins booting Windows.

Finally, the WinXP Registry is a huge and vital database containing the settings (both standard and custom) established for all hardware and software installed on the computer, including WinXP. These settings are stored in strings of data called keys. Windows wouldn't know where to look for programs without the Registry.

Step 1: Let The Tests Begin

From the moment you press the power button on your PC, it begins performing tests to make sure all its hardware components are functioning properly. This begins at the power supply, checking to make sure there's a stable supply of juice, before telling the CPU that it can safely turn itself on.

As soon as the CPU comes to life it activates the BIOS, which immediately initiates a series of basic hardware tests, making sure the memory and keyboard are fully functional and also performing a self-test to make sure there's exactly the right amount of data stored in the BIOS chip. (Discrepancies here may indicate that the BIOS was flashed improperly or that a BIOS virus is present.)

Once the BIOS has checked itself out, it searches for any other devices installed on the computer that have their own BIOS chips and gives them a chance to initialize. Video cards, for example, commonly have

BIOS chips installed, so errors here generally indicate display issues.

Each time you exit WinXP, you set a flag that tells the BIOS whether you reset the computer (warm-start) or turn off the computer completely (cold-start). At this point the BIOS reads that flag and carries the information it contains over to the next major step in the boot process, the POST (power on self test).

Step 2: On To The POST

So far, everything the PC has done during the boot process has been transparent to the user because the video display subsystem is not initialized yet, but the display becomes active during the POST. If the flag retrieved during the previous step indicates that a cold start is taking place, the BIOS performs a complete POST, beginning with a check of the memory banks. If you've ever seen a boot screen displaying memory capacities that rise as you watch, you've seen this portion of the POST.

If the BIOS detects a warm-start, the POST skips the memory check to save time, and regardless of the type of startup, a screen appears containing the name and version number of the BIOS currently in use. Write this information down and check the computer or motherboard manufacturer's Web site to see if a BIOS upgrade is available, as keeping the BIOS up-to-date mitigates compatibility problems. The POST screen also displays information about any errors that it detects (check the manual that came with your mobo to determine what each error code or message means), and it usually displays the name of a key users can press to access BIOS settings before the PC boots into Windows. These settings vary from computer to computer, and mucking around in the settings screen without knowing what you're doing can have serious consequences. If you ever want to do things such as change the speed of the memory bus, change the AGP aperture size to accommodate a new video card, or change the boot order of your drives, the BIOS settings interface will let you do all that and more.

When the POST is complete, the BIOS fetches the current time and boot order from the motherboard's CMOS chip, then turns to the MBR for help.

AWARD BIOS Beep Codes

The AWARD BIOS relies mainly on error messages to alert users to problems, but there are some known beep codes emitted by the motherboard with this BIOS chip.

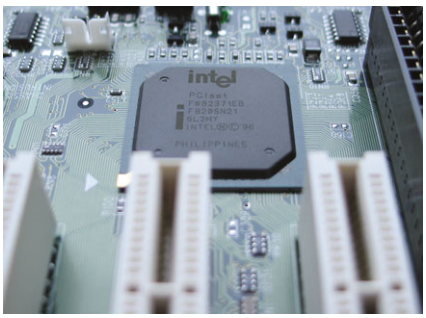
Number Of Beeps During POST	What It Means
Unlimited (repeating)	System memory error
One long beep followed by two short beeps	Video card error
One long beep followed by three short beeps	Video card or video card memory error
Unlimited (repeating) high-pitched beeps	CPU overheat error
Unlimited (repeating) high-pitched and low-pitched beeps	CPU error

Step 3: Reading The Boot Sector

No, Boot Sector isn't sci-fi slang for some far-flung corner of the universe. It's the portion of the hard drive that contains all of the data needed to initialize WinXP. It contains the MBR, which performs several tasks once the BIOS calls on its services.

Firstly, the MBR must locate and launch a program called Ntldr (NT Loader). This small but powerful program opens up resources on your system that the BIOS couldn't touch, such as all of the memory in the RAM banks, and it also detects and launches the file system used by your OS. On a WinXP machine, the file system is either FAT32 (32-bit File Allocation Table) or NTFS (NT File System), depending on how you formatted the hard drive when you installed WinXP.

All of the information necessary to initiate the boot process is found on this BIOS chip.



During startup, the BIOS communicates with other chips on the motherboard, such as this Intel chipset that controls the video port and other hardware devices.

Ntldr also reads and acts upon the contents of an initialization file called Boot.ini. This is a text file that contains parameters used to boot WinXP, and you can configure these parameters manually if you want. Boot.ini is not nearly as important in WinXP as it was in previous OSes, where it contained reams of commands on some machines, but it is still included for legacy support, to give users more control over the boot process and to store the disk path where WinXP resides.

Once it reads Boot.ini, Ntldr initializes the boot screen if WinXP is installed in a dual- or multi-boot configuration. For example, if you've installed WinXP and Windows Me on the same computer, the boot menu lets you pick the OS you want to load for the current session.

If you select WinXP (or if WinXP is the only OS installed on the computer), Ntldr launches a program called Ntdetect that gathers information about the hardware installed on the system, comparing it to a database of known hardware stored in the WinXP Registry.

Step 4: Windows At Last

When the hardware checks out, Ntldr loads a program called Ntoskrnl (NT Operating System Kernel), which is the core file WinXP requires for basic functionality. It also loads another program called HAL (Hardware Abstraction Layer), which serves to keep the system kernel separate

from the system hardware so that a hardware failure beyond this point can't crash the entire system. As its final act, Ntldr loads drivers for the boot drive and then gives control to Ntoskrnl.

At this point the WinXP logo appears on-screen with a bar at the bottom that cycles across the screen as Ntoskrnl goes through a two-phase initialization procedure. In Phase 0 the WinXP kernel assumes control of the basic hardware required for the operation system to function. In Phase 1 the HAL program configures the computer to accept data from attached hardware, a process that includes starting up WinXP's Memory Manager, Cache Manager, I/O (Input/Output) Manager, and other basic services.

The large chip on the right controls I/O devices, and is called upon during the I/O initialization phase of the boot process. The small chip on the left is a sensor that monitors fan speeds and device temperatures and generates beep codes when devices are too hot.

The I/O manager loads all of the other drivers for hardware installed on the computer, a SMSS (Session Manager Subsystem) program prepares graphics systems for use, and then a program called Win32k.sys fires up to actually switch the PC into graphics mode. SMSS loads all WinXP services configured to start automatically at startup, and then two programs called Winlogon (Windows Logon) and LSASS (Local Security Authority Service) work together to load the login screen that welcomes you to WinXP.

When Things Go Wrong

Because the boot process is designed to check all of the most important pieces of hardware installed on a computer, not all boot procedures go off without a hitch. Sometimes startup tests detect a problem big enough to crash the entire system without any warning, but in most cases you'll instead see an error message that provides some insight into the problem.

If you see an error message that you don't understand, jot it down and contact the computer's manufacturer immediately, as the company's tech support staff should have a good idea what's causing the problem. Sometimes no error message appears, but the computer emits one or more beeps instead. These aren't random; they serve as a sort of Morse code BIOS manufacturers can use to tell users the source of a problem when it is impossible to display an error message. Check the beep code sidebars at the end of this article for specific information regarding beep codes for AWARD and AMIBIOS BIOSes. Unfortunately we lack the space to list codes for the Phoenix BIOS, which uses more than 100 beep code variations—you'll need manufacturer help to make a Phoenix-equipped motherboard rise from the ashes. CPU

by Tracy Baker

AMIBIOS8 Beep Codes

American Megatrends' AMIBIOS is a common BIOS, and the latest version has a number of beep codes to tell users when things are going wrong during the boot process.

Number Of Beeps At Startup (Before POST)	What It Means
1	Insert diskette into floppy drive A:
2	AMIBOOT.ROM file not found on bootable floppy diskette
3	System memory error
4	Flashing operating successful (after upgrading BIOS)
5	Floppy diskette read error
6	Keyboard batch command failure
7	No BIOS flash memory detected
8	Floppy diskette controller failure
9	BIOS checksum error
10	Flash memory erase error
11	Flash memory programming error
12	AMIBOOT.ROM file is not the correct size (may indicate virus is present)
13	BIOS ROM image mismatch (ROM file does not exactly match the copy stored in the BIOS)
Number Of Beeps During POST	**What It Means**
1	System memory refresh timer error
2	System memory parity error
3	System memory read/write test error
4	Motherboard timer not operational
5	CPU error
6	Computer cannot switch to protected mode memory
7	General exception error (CPU-related)
8	Display memory error (related to video card)
9	AMIBIOS ROM checksum error
10	CMOS shutdown register read/write error
11	Cache memory test failure

NOTE: If you hear one, two, or three beeps during the POST process, consider replacing your RAM modules or at least checking them to make sure they are installed properly. If you hear eight beeps during the POST check to make sure the video card is installed properly, as you may need to replace it. If you hear any other number of beeps (four through seven or nine through 11) during the POST, there may be a serious problem with your motherboard or other components, so contact technical support.

Hard Drives

Maxtor MaxLine II QuickView EIDE 300GB

We'll start this issue's hard drive section with some EIDE models, also known as ATA, PATA, and UltraDMA drives. They're getting short shrift as the Serial ATA (SATA) interface takes over, but there's still room for a new ATA/100MBps or ATA/133MBps drive in mini-ITX and older computers.

Our test drives range from 80-300GB, but don't worry if you don't see a particular drive in a particular capacity. Hard drive families usually perform about the same throughout their capacity ranges, although smaller drives may have quicker accesses, smaller caches, and other differences.

Despite the Maxtor QuickView line's modest 2MB buffers, the company says that the heat-monitoring drives are optimized for smooth AV streaming in DVRs and other standalone consumer devices. A 5,400rpm spindle speed borne by fluid dynamic bearings is plenty fast enough for even today's high-resolution AV streams, yet keeps heat and noise emissions low. The QuickViews are generally sold to OEMs, but you can get them online.

This drive's model number is technically 5A300J0-QV, although our example was labeled simply "5A300J0." The "MaXLine II" appellation at the top promises trouble-free longevity at the expense of some speed, as our tests show. That nice burst read rate results from Maxtor's 133MBps interface, but represents a fleeting, occasional benefit.

QuickViews are available from 40-300GB. The 300GB model is quiet at 25dB idle/36dB seeking, and fairly resilient at a 300G nonoperating 2ms shock tolerance. ▲

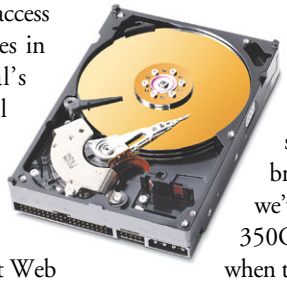
by Marty Sems

How we tested EIDE Hard Drives

PCMark04 1.2.0 with WMP 9 at default settings, NTFS drive, 16KB clusters; HD Tach 3 with 32MB zones, unpartitioned drive; IOmeter 2003.5.10, unpartitioned drive, File Server test at 1 user/16 outstanding I/Os, Web Server test at 4 users/64 total outstanding I/Os. Test PC: NCQ-capable Intel ICH6R controller, 2.8GHz P4 (LGA775/800MHz/1MB), 1GB Corsair PC4200 DDR2, GIGABYTE PCX 5900 128MB, ASUS P5AD2 Premium Wireless mainboard.

EIDE Hard Drive	
Maxtor MaxLine II QuickView 300GB	
Final Word	Nice and spacious for stationary PVRs and AV servers
Price	$231 online
Interface	ATA/133
Spindle Speed (rpm)	5,400
Cache Buffer (MB)	2
PCMark04 1.2.0	
Hard Drive	3353
HD Tach 3	
Average Read (MBps)	39.9
Maximum Read (MBps)	48
Burst Read (MBps)	115.6
Random Access (ms)	22.3
Avg. Read Seek Time, Advertised (ms)	≥12
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	72
Web Server	92.87
For More Information	www.maxtor.com
Overall Rating	

Western Digital Caviar Special Edition EIDE 120GB



With the lowest random access score of the EIDE drives in this section, Western Digital's WD1200JB proves that it's still potent after all this time. Also, of all the drives here, this Caviar seems most suited to ATA server duty, with the top File Server score and second-best Web Server rating in IOmeter.

The "Special Edition" part of this 7,200rpm drive's name meant an 8MB cache buffer when, a few years ago, 2MB buffers were the norm. Although there's only a modest speed gain from having such a big cache in everyday usage, Western Digital spurred other drive manufacturers to follow suit. Today, 8MB buffers are the rule, not the exception.

FDBs (fluid dynamic bearings) are another innovation that's almost universal today. The WD1200JB has them, although they don't seem to make the drive's motor much quieter. In fact, the WD1200JB is downright noisy by today's standards at 35dB idle/37 and 39dB seeking. Still, this is a tougher breed of Western Digital than we've seen in years past, with a 350G tolerance of a 2ms shock when the drive is inactive.

Despite its quick accesses and server test scores, the WD1200JB looks more like an also-ran in other benchmarks in the face of competitors from Hitachi GST, Maxtor, and even Samsung (yeah, Samsung). HD Tach in particular didn't seem to care for the way WD orchestrated that 8MB cache, returning a low 79.5MBps burst read rate. More importantly, the software placed the WD1200JB's average and maximum read rates in the lower half of the pack. PCMark04 placed the drive squarely in the middle.

EIDE Hard Drive	
Western Digital Caviar SE WD1200JB 120GB	
Final Word	Whip-snap accesses make this drive ATA server fodder
Price	$83 online
Interface	ATA/100
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	4358
HD Tach 3	
Average Read (MBps)	45.5
Maximum Read (MBps)	54
Burst Read (MBps)	79.5
Random Access (ms)	12.5
Avg. Read Seek Time, Advertised (ms)	8.9
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	102.29
Web Server	117.92
For More Information	www.westerndigital.com
Overall Rating	

Remember: hard drive benchmarks split hairs. You'd be hard-pressed to tell the difference among any of the 3.5-inch, 7,200rpm drives here during normal use. ▲

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

HITACHI GST DESKSTAR 7K250 EIDE 164.7GB

Hitachi GST took IBM's hard drive ball and ran with it, and hasn't fumbled yet. The Deskstar 7K250 is a good example of how to do a hard drive correctly.

Hitachi's AFC (antiferromagnetically)-coupled recording media, nicknamed "pixie dust" by its inventor IBM, lets the drive's platters store 62Gb per square inch. Special ramps let the read/write heads park off the platters when the drive shuts down, freeing up a bit of storage space and helping the unit reach a 350G nonoperating 2ms shock tolerance score.

The 7K250 line uses FDB bearings throughout its 40-250GB range. Like most of the other EIDE drives shown here, it also comes in SATA trim and has a thermal monitoring feature. The line is quiet enough for DVR and music server duty with 26-30dB noise levels at idle, depending upon capacity (our 160GB had a 28dB idle rating).

Leading the group in PCMark04 and IOmeter's Web Server benchmark, the 7K250 also tied Samsung's SP1614N and Maxtor's DiamondMax Plus 9 for first place in maximum read rates. The 7K250 almost tied the Western Digital WD1200JB for best random access time, as well. The drive made better use of the ATA/100 interface than the rest of the non-Maxtor drives, too, squeezing out 96.5MBps in burst reads. The Maxtor DM+9 read an average of 4MBps faster than this Hitachi, but the 7K250 edged out that drive overall, especially in organizing multiple outstanding data requests.

EIDE Hard Drive	
Hitachi GST Deskstar 7K250 164.7GB	
Final Word	Still an outstanding performer today
Price	$93 online
Interface	ATA/100
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5107
HD Tach 3	
Average Read (MBps)	49.3
Maximum Read (MBps)	62
Burst Read (MBps)	96.5
Random Access (ms)	12.6
Avg. Read Seek Time, Advertised (ms)	8.5
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	95.66
Web Server	129.34
For More Information	www.hitachigst.com
Overall Rating	

Our HDS722516VLAT80 drive packs an 8MB cache. Certain 7K250 drives come with either 8MB or 2MB buffers, so cross-check with Hitachi's site before you buy. ▲

by Marty Sems

SEAGATE BARRACUDA 7200.7 EIDE 160GB

The biggest name in hard drives, Seagate, was one of the first to recognize where the market was headed. In the case of desktop drives, Seagate foresaw that it would become more and more important to end users to have quiet systems. With the introduction of the Barracuda ATA IV a few years ago—a drive that's virtually silent when it's not seeking and barely audible when it is—Seagate sent a shot across the bow of competing manufacturers. Today, other vendors offer quieter flagship drives in an attempt to vie with Seagate for space in standalone electronics and SFF systems.

Our Barracuda 7200.7, model number ST3160021A, is a 7,200rpm drive as its name indicates. It only has a 2MB buffer, but as its test scores proved, supersonic speed isn't the ATA/100 7200.7's first priority. It placed third in IOmeter's Web Server test, but that's about it for trophies. At this writing, the 7200.8 and several other new Seagates were as yet unavailable.

Like other desktop Seagates, the ST3160021A is all about quiet reliability. It registers at just 25dB when idle, the merest whisper above the aforementioned Barracuda ATA IV a few generations back. Seagate didn't provide us with seek acoustic ratings, but we could barely hear any activity from the drive over the thrum of our test PC's fans.

As for reliability, the 7200.7 has an unsurpassed five-year warranty. Like other manufacturers, Seagate temporarily shortened many of its drives' warranty periods this past year, only to one-up the rest when the trend abruptly reversed itself. Really, drives today are more reliable than ever before, except when mishandled. And you won't have to feel like you're defusing a bomb when you're installing a 7200.7, thanks to its excellent 350G nonoperating 2ms shock tolerance. ▲

EIDE Hard Drive	
Seagate Barracuda 7200.7 160GB	
Final Word	Silent and long-lasting rather than speedy
Price	$86 online
Interface	ATA/100
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	2
PCMark04 1.2.0	
Hard Drive	3807
HD Tach 3	
Average Read (MBps)	46.9
Maximum Read (MBps)	58.5
Burst Read (MBps)	91.9
Random Access (ms)	16
Avg. Read Seek Time, Advertised (ms)	8.5
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	85.52
Web Server	112.6
For More Information	www.seagate.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Samsung SpinPoint SP1614N EIDE 160GB

Like so many storage geeks, we had to suppress a smirk a few years ago when Samsung told us that it was gonna get serious about hard drives again. Long the laughingstock of the platter pundits, Samsung wasn't exactly known for drives that performed very well or, indeed, lasted very long.

As character actor Edward Herrmann often said so convincingly for Chrysler back in the day, the rules have changed. The Samsung SP1614N 160GB is yet another exhibit for the defense. Even with a 7,200rpm spindle motor with FDB, the SpinPoint is nice and quiet at 27dB idle and 28dB random read and write noise levels. It's stout, too, with a 350G nonoperating 2ms shock rating.

The SP1614N tied for the top maximum read rate among the EIDE drives we tested. It even took second or third in most of the other criteria not in just one, but across all three software benchmark titles. Its 8MB cache and ATA/133 compatibility didn't seem to help the drive get as good of a burst read rate as it should have, but the Samsung did best Maxtor's vaunted DM+9 in a handful of tests.

One nice thing about all of the Samsung hard drives we tested was that, even in bare trim with no retail packaging, they still came with a packet of mounting screws. And just as the company chose to use Maxtor's ATA/133 interface, it also borrowed Seagate's idea for cushioning, static-resistant plastic shipping shells.

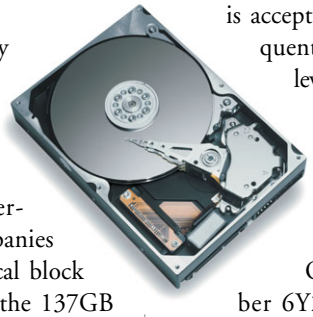
Nobody really brags about having a Samsung HDD in his rig when he lists his parts for all to see. After testing several of the chaebol's drives in the new millennium, however, we don't think it will be long before someone does. ▲

by Marty Sems

EIDE Hard Drive	
Samsung SpinPoint SP1614N 160GB	
Final Word	Drives like this will earn Samsung HDDs a better rep
Price	$90
Interface	ATA/133
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	4787
HD Tach 3	
Average Read (MBps)	50.5
Maximum Read (MBps)	62
Burst Read (MBps)	88.3
Random Access (ms)	13.6
Avg. Read Seek Time, Advertised (ms)	8.9
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	100.72
Web Server	111.77
For More Information	www.samsung.com
Overall Rating	CPU CPU CPU CPU

Maxtor DiamondMax Plus 9 EIDE 200GB

Power users often look no further than Maxtor for all their hard drive needs. When speed is an issue, you'll usually find a Maxtor at or near the top of the list.



Years back, the company was the first to overcome the 137GB addressing limit inherent in the ATA specification by introducing the evolutionary ATA/133 interface. Other hard drive companies added their own 48-bit logical block addressing workarounds for the 137GB limit, but only Samsung broke ranks and licensed the ATA/133 spec. In most cases, an ATA/133-compliant controller and drives shouldn't restrict the throughput of a fast RAID, as ATA/100 can.

The stalwart DiamondMax Plus 9 has been Maxtor's go-to drive since the days of the D740X (flip ahead a page or two for a look at Maxtor's new SATA DiamondMax 10 with a 16MB cache). The line spans 60 to 250GB capacities, most of which are available with either 2 or 8MB buffers. As is customary for most drive makers, the SATA versions all have 8MB caches.

At 7,200rpm using FDB, the DM+9 is acceptably quiet during long sequential accesses, with acoustic levels of 27dB idle/35dB seeking. It can withstand a 300G shock of 2ms duration when off, so it's a bit more fragile than some other 3.5-inch drives.

Our test drive, model number 6Y200P0, demonstrated its ATA/133 support with a very high burst rate of 116.7MBps. More usefully, it also won the average read rate contest and tied with the Hitachi and Samsung for best maximum read rate. On the other hand, its so-so 14ms random access rate probably dragged down the drive's PCMark04 and IOmeter Web Server scores. We can't explain the DM+9's bizarrely low File Server score, but we did double-check our results. In any case, the DiamondMax Plus 9 name will still draw nods of reverence for some time. ▲

by Marty Sems

EIDE Hard Drive	
Maxtor DiamondMax Plus 9 200GB	
Final Word	Topped our read rate tests, but showing some age in other areas
Price	$104
Interface	ATA/133
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	4696
HD Tach 3	
Average Read (MBps)	53.1
Maximum Read (MBps)	62
Burst Read (MBps)	116.7
Random Access (ms)	14
Average Read Seek Time, Advertised (ms)	≥9.3
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	52.52
Web Server	110.93
For More Information	www.maxtor.com
Overall Rating	CPU CPU CPU CPU

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

HITACHI GST TRAVELSTAR 5K100 EIDE 80GB

The latest 2.5-inch hard drives, all about the size of a stack of three or four credit cards, are opening up all sorts of new avenues for CE builders and power users alike. No longer constrained to sedate 4,200rpm spindle speeds and minuscule capacities, these tough, power-saving drives are reaching the speeds and capacities desktop drives had in recent years.

Hitachi's new Travelstar 5K100 is a 5,400rpm variant which, the company claims, won't drain a notebook battery much more than a 4,200rpm drive. A 600,000 load/unload (power on/off) expected life cycle and a 1,000G nonoperating shock tolerance (1ms; 300G operating, 2ms) hints at why you want one of these in your mini-ITX concoction. FDB bearings keep heat and noise output down, while a large 8MB cache keeps data close at hand.

The 5K100 line covers 40 to 100GB capacities. Our 80GB drive, model HTS541080G9AT00, had four glass platters with areal densities of 70Gb/si. The 100GB edition has the same configuration with the exception of 86Gb/si disks. Our drive's acoustic levels ranged from 25dB when idle to 27dB when seeking. By the way, the entry-level 40GB model brings those figures down to 22dB idle/24dB seeking, in case you need absolute silence for a fanless system.

Our drive had a 44-pin connector, so we used a passive data/power adapter to mate it to our 39-pin ATA/133 cable. Its benchmark scores only look impressive next to other notebook drives with similar specs, although the 5K100 did trade some body blows with the full-sized 5,400rpm Maxtor QuickView in a few tests. Check out Western Digital's 5,400rpm Scorpio and Seagate's Momentus 5400.2, as well. ▲

EIDE Hard Drive	
Hitachi GST Travelstar 5K100 80GB	
Final Word	SFF, mini-ITX, HTPC...the scales are tipping toward 2.5-inch HDDs
Price	$170
Interface	ATA/100
Spindle Speed (rpm)	5,400
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	3413
HD Tach 3	
Average Read (MBps)	31.2
Maximum Read (MBps)	41
Burst Read (MBps)	96.3
Random Access (ms)	16.6
Avg. Read Seek Time, Advertised (ms)	12
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	77.96
Web Server	91.26
For More Information	www.hitachigst.com
Overall Rating	

by Marty Sems

HITACHI GST DESKSTAR 7K400 SATA 400GB

The Deskstar 7K400 is one of very few drives to reach 400GB thus far—the rest are at Seagate—and it's the only one shipping at this writing. What bugs us is that, unlike just about every other hard drive line in the world, it doesn't come in any smaller capacities. As of this writing, if ye be wantin' a 7K400, ye be payin' $370, and ye be gettin' 400GB.

Still, 400 speedy gigabytes is a happy thought by itself. Big used to equate to slow in the hard drive world, but this Hitachi drive has disproved that notion. Our test unit was second only to the 10,000rpm WD Raptor in random access time (12.6ms), even shouldering out the latest Seagate Barracuda 7200.7. The 7K400 also tied the WD2500SD RAID Edition for second place in maximum read rates with 62MBps. Finally, it was a close third in PCMark04, just a few points behind Maxtor's new DiamondMax 10 with a 16MB cache.

We should mention that our HDS724040KLSA80 model did this well even though it may have had something wrong with it. Its head movements were clearly audible during random access testing, although with a high 31dB noise rating when idle, this could be normal. The 7,200rpm drive with FDB also heated up quite a bit when not mounted in front of a fan. Finally, the BIOS on an ASUS P4P8X motherboard in our hardware testing labs repeatedly had trouble recognizing the drive at all, although the drive worked fine on the ASUS P5AD2 used in this section's test computer.

Hitachi's feature list sounds a lot like Western Digital's, including latched SATA connectors and hot pluggability. All that space comes at a price, though: five platters and ten heads drop the 7K400's nonoperating shock tolerance to 225G (2ms). ▲

SATA Hard Drive	
Hitachi Deskstar 7K400 400GB	
Final Word	The biggest drive around for now, and pretty fast, too
Price	$370 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5449
HD Tach 3	
Average Read (MBps)	48
Maximum Read (MBps)	62
Burst Read (MBps)	125.7
Random Access (ms)	12.6
Avg. Read Seek Time, Advertised (ms)	8.5
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	98.12
Web Server	127.37
For More Information	www.hitachigst.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless, 2.5 = Absolutely Average, 5 = Absolutely Perfect

Western Digital WD2500SD RAID Edition SATA 250GB

Kicking off our SATA drive reviews is Western Digital's WD2500SD RAID Edition. A few features make this drive more compatible with RAID controllers and SATA servers than typical desktop drives. One is TLER, WD's time-limited error recovery feature, which helps keep controllers from kicking a drive out of an array when an error correction is taking longer than usual. However, WD says that because of TLER, you shouldn't choose this drive unless you plan to use it in a server.

Other items of note include the WD2500SD's rear SATA data and power ports, which are aligned to fit server backplanes. The drive's SATA connectors also have little notches on top for tighter conections with WD's cables. The WD2500SD is also hot-pluggable, but bear in mind that its slight 65G operating/250G nonoperating tolerances for 2ms shocks before you yank on it.

Using FDB, the WD2500SD-01KCB0 we bought spun three platters at 7,200rpm with an 8MB cache standing at the ready. Actually, we bought two of these drives to check out the model's performance in a RAID 0. The results are in the accompanying chart, contrasted with a pair of non-RAID Edition WD2500JD 250GB set up in a Matrix RAID (types 0 and 1 on different partitions) on the same Intel ICH6 controller.

As a solitary drive, the WD2500SD came in second place in average and maximum reads among the SATA drives reviewed here. It's moderately quiet at 28dB idle/29 to 33dB seeking noise levels and has a 1 million hour MTBF. ▲

by Marty Sems

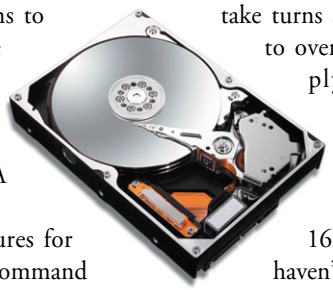
How We Tested SATA Hard Drives

PCMark04 1.2.0 with WMP 9 at default settings, NTFS drive, 16KB clusters; HD Tach 3 with 32MB zones, unpartitioned drive; IOmeter 2003.5.10, unpartitioned drive, File Server test at one user/16 outstanding I/Os, Web Server test at four users/ 64 total outstanding I/Os. Test PC: NCQ-capable Intel ICH6R controller, 2.8GHz P4 (LGA775/800MHz/1MB), 1GB Corsair PC4200 DDR2, GIGABYTE PCX 5900 128MB, ASUS P5AD2 Premium Wireless mainboard.

SATA Hard Drive	
Western Digital WD200SD RAID Ed. 250GB (and x2 in RAID 0, 128KB; and WD2500JD 250GB non-RAID Ed. x2 in Matrix RAID 0 & 1, 128KB)	
Final Word	Very competent, with lots of RAID- and server-friendly features
Price	$190 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5381 (6599; 5634)
HD Tach 3	
Average Read (MBps)	52.3 (103.3; 56.2)
Maximum Read (MBps)	62 (122; 69)
Burst Read (MBps)	123.7 (220.4; 145)
Random Access (ms)	13.2 (13.6; 10.2)
Avg. Read Seek Time, Advertised (ms)	8.9
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	99.53 (166.83; 189.5)
Web Server	121.58 (214.3; 237.46)
For More Information	www.westerndigital.com
Overall Rating	CPU CPU CPU CPU

Maxtor DiamondMax 10 SATA 250GB

Maxtor's DiamondMax 10 was, along with Seagate's recent version of the Barracuda 7200.7, one of the first drives to support the SATA II specification (also known as extensions to SATA 1.0a, revision 1.1). While still a 150MBps interface, not the upcoming 300MBps edition, SATA II delivers features that more fully round out SATA drives' potential for server use.



Chief among these new features for most users is NCQ, or native command queuing. Put simply, NCQ lets a hard drive choose the order in which it will return the data requested of it by the host computer. A system could ask an NCQ drive for up to 32 chunks of data, but instead of retrieving them in a first-come, first-served fashion, the drive will choose the fastest route instead. If this sounds a little like SCSI, it should. Of course, you'll also need an NCQ-compliant controller, such as Intel's ICH6R or Silicon Image 3124-x, to enjoy NCQ.

Other SATA II benefits include more comprehensive support for hot-plugging drives, as well as staggered spinup, which causes multiple drives in a system to take turns starting up so as not to overload the power supply. The DM10 line spans capacities of 80 to 300GB.

The 250GB and 300GB models have 16MB caches, which we haven't seen since the "AV" drives of the late 1990s. The lesser capacities all have 8MB buffers.

In our test PC with an NCQ-compatible ICH6R controller, our 6B250S0 proved its command queueing prowess. It finished second in IOmeter's File Server test, which loads up a drive with outstanding data requests, but only placed fifth in the more arduous Web Server test. Perhaps the uncharacteristically slow 16.5ms random access time held the drive back a bit. The DM10 did take the silver in PCMark04 and burst reads, however. ▲

by Marty Sems

SATA Hard Drive	
Maxtor DiamondMax 10 250GB	
Final Word	A 16MB cache & SATA II benefits: NCQ, hotplugging, staggered spinup
Price	$190 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	16
PCMark04 1.2.0	
Hard Drive	5463
HD Tach 3	
Average Read (MBps)	48
Maximum Read (MBps)	59
Burst Read (MBps)	131
Random Access (ms)	16.5
Avg. Read Seek Time, Advertised (ms)	<9.0
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	111.32
Web Server	126.08
For More Information	www.maxtor.com
Overall Rating	CPU CPU CPU CPU

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

Seagate Barracuda 7200.7 SATA 160GB

The Barracuda 7200.7 has been around for a while, but latter-day units have something extra: NCQ and other SATA II enhancements, as described in the previous review. The SATA II extensions are not available via firmware update, so you can't upgrade an old SATA 7200.7 to use NCQ. Seagate says it started shipping the new SATA II 7200.7s in June 2004. Our OEM drive kept the pre-NCQ model number ST3160023AS; look for ST3160827AS for an NCQ drive in retail channels.

Seagate says NCQ adds some speed to OS/game/app-loading, Photoshop rendering, Access database and AutoCAD sessions, and of course, server duty. NCQ also naturally complements Intel's Hyper-Threading and upcoming technologies that allow a processor to work on several program threads simultaneously, as each thread generates its own data requests. Again, your motherboard or SATA adapter card must have an NCQ-compatible controller chip.

Our drive took well to the ICH6R controller in our test PC, showing off with second and third place finishes in our server tests. In fact, its Web Server score was second only to the 10,000rpm WD Raptor, which swept our tests as expected.

Our other benchmarks didn't give NCQ as much of a workout. The 7200.7's 12.7ms access time was the highlight, taking third place just a hair behind the impressive Hitachi 7K400. The rest of the Seagate's scores were right in the thick of the 7,200rpm drives' results, which formed a very tight group.

All this, plus a five-year warranty. If you're building a new PC, there's little reason not to build NCQ support and a new 7200.7 into it—unless you're waiting for the 7200.8. ▲

SATA Hard Drive	
Seagate Barracuda 7200.7 160GB, SATA II	
Final Word	NCQ and a quick access time gave us nice server scores
Price	$97 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5115
HD Tach 3	
Average Read (MBps)	48.1
Maximum Read (MBps)	61
Burst Read (MBps)	122.8
Random Access (ms)	12.7
Avg. Read Seek Time, Advertised (ms)	8.5
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	106.75
Web Server	141.62
For More Information	www.seagate.com
Overall Rating	

by Marty Sems

Western Digital Raptor SATA 74.3GB

The Raptor WD740GD is still unmatched among SATA drives, whether you're talking about raw performance or its 10,000rpm spindle speed. As you can see from our test results, the competition may occasionally approach the Raptor's lofty perch, but none can yet reach or exceed it.

The trade-off, unfortunately, is cost per gigabyte. WD hatched the Raptor out of a SCSI platform, which generally indicates smaller diameter hard disks for stability at higher rpms. Raptors have come down quite a bit in price, however. Noise is also noticeable at 32dB idle/36dB seeking.

The WD740GD uses tagged command queuing, which differs a bit from SATA II's NCQ. TCQ-compatible adapter cards include HighPoint's PCI-X RocketRAID 1820a and Pacific Digital's Talon ZL-2, Talon ZL-4, and RAIDStaQ SATA150. The drive also has FDB bearings, plus notched SATA connectors that click like a seat belt with the company's SecureConnect cables.

Wear your kid gloves when you're handling the Raptor, however. Its 250G shock tolerance (2ms, nonoperating) is 50 to 100G under the limits of today's tougher drives. The drive has an outstanding 1.2 million hour mean time between failures, but with a rating of only 20,000 start/stop cycles, the WD740GD seems to be better suited to being run full time than turned on and off each day.

There's not much to say about the Raptor's benchmark scores except the obvious: It swept our tests. Some tests better show the drive's superiority, but it's clear that there's still no better choice for your SATA server. OK, back to the reality of a single-user game PC or workstation. For the same price, you can build a SATA RAID 0 with more speed and space than a single Raptor. But there's a catch: You'll be haunted by the fact that you could've spent a little more and RAIDed two Raptors instead. ▲

SATA Hard Drive	
Western Digital Raptor SATA 74.3GB	
Final Word	Still the SATA king; swept our scores, but high cost per GB
Price	$173 online
Interface	SATA
Spindle Speed (rpm)	10,000
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	6117
HD Tach 3	
Average Read (MBps)	55.8
Maximum Read (MBps)	68
Burst Read (MBps)	145.2
Random Access (ms)	10.2
Avg. Read Seek Time, Advertised (ms)	4.5
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	165.82
Web Server	187.13
For More Information	www.westerndigital.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Hitachi GST Deskstar 7K250 SATA 82.3GB

Here's the SATA version of the Deskstar 7K250 from Hitchi Global Storage Technologies, whose EIDE version we covered a few pages back. Although this 7K250 tested out as well as the bigger ATA/100 version in every category except random access time, the drive faced tougher competition with other drives in the SATA category.

This Deskstar is still a solid choice if your PC has SATA but lacks NCQ support. The $64 82.3GB edition that we bought is a pretty good value, too. The newer Deskstar 7K400 would be a better choice, except for the fact that it's only available in a $370 400GB configuration so far. Ouch.

Serial ATA 7K250s come in 80 to 250GB capacities, all with 8MB buffers. Our single-disk unit took a 0.3ms penalty in advertised seek time compared to the bigger models but got its own back with a lower 26dB idle acoustic rating. In addition, its off-disk load/unload ramps for the heads helps the 7K250 garner a nice 350G nonoperating 2ms shock tolerance.

Our 82.3GB Deskstar, model HDS722580VLSA80, tended toward the middle to low end of this brutal SATA drive group in benchmark scores. On the other hand, its IOmeter Web Server score was the third best of the flock, and its max read rate was right up there with the best 7,200rpm drives.

One puzzler was its inordinately low File Server ranking. Still, 120GB and larger SATA 7K250s should perform a little better thanks to their slightly quicker seeks. ▲

by Marty Sems

SATA Hard Drive	
Hitachi GST Deskstar 7K250 82.3GB	
Final Word	Still competitive, but its 7K400 sibling and NCQ drives outshine it
Price	$64 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5135
HD Tach 3	
Average Read (MBps)	48.8
Maximum Read (MBps)	61.5
Burst Read (MBps)	125.8
Random Access (ms)	14.4
Avg. Read Seek Time, Advertised (ms)	8.8
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	88.7
Web Server	131.9
For More Information	www.hitachigst.com
Overall Rating	

Samsung SpinPoint SP0812C SATA 80GB

South Korean juggernaut Samsung keeps surprising its critics with decent hard drives. The SP0812C isn't the cream of this roundup's crop, but it still pulled down some respectable numbers in our testing regimen.

Samsung calls this drive hot-pluggable, but it's unclear if the company merely means that it shares the limited hot-pluggability and hot-swappability of the first generation of SATA units.

There's no mention of NCQ or other cutting-edge SATA II extensions in the drive's documentation, although the drive's vital statistics otherwise read just like those of the top 7,200rpm drives today.

The SP0812C houses a spindle motor with FDB bearings, which helps the drive run almost as quietly as a Seagate at 27dB idle/28dB seeking acoustic levels. And speaking of Seagate, this Samsung is just as resilient, able to withstand a shock of 350G over a 2ms period when not powered up.

A couple of this SpinPoint's benchmark scores stand out. The more useful of the two is the drive's 49.6MBps average read rate, which was the third best in this group of SATA drives, including the Raptor. The Samsung also took the bronze medal in burst read rate (129.7MBps), although such cached data hits are too sporadic and brief to notice. Apart from an oddly low PCMark04 score, considering, the SP0812C handed in a fair to middling performance in the rest of the categories.

Power users may continue to look past this and other Samsung drives, at least until the company comes up with a paradigm-shifting innovation or two. For typical users looking for good speed on a budget, however, Samsung is definitely in the running. ▲

by Marty Sems

SATA Hard Drive	
Samsung SpinPoint SP0812C 80GB	
Final Word	Doesn't give up much to the bigger names here
Price	$72 online
Interface	SATA
Spindle Speed (rpm)	7,200
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	4925
HD Tach 3	
Average Read (MBps)	49.6
Maximum Read (MBps)	59
Burst Read (MBps)	129.7
Random Access (ms)	13.3
Avg. Read Seek Time, Advertised (ms)	8.9
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	101.77
Web Server	115.67
For More Information	www.samsung.com
Overall Rating	

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Seagate Savvio Ultra320 SCSI 73.4GB

It's completely nuts. It must've been hard to engineer reliable 5,400rpm 2.5-inch hard drives, let alone 7,200rpm models for desktop replacement notebooks. But a 10,000rpm SCSI drive in this tiny form factor? That's crazy talk.

Just a few years ago, as Seagate was showing off its remarkable new facility in Longmont, Colo., the company wouldn't admit that it was interested in the small drive biz. We didn't doubt Seagate's sincerity at the time, but the Momentus and other pocket rockets appeared just a little too quickly to suggest a, ahem, sea change.

So did the Savvio, with its 8MB cache, low power requirements, and five-year warranty. Seagate says to imagine six Savvios in a 1U blade server instead of just two 3.5-inch drives, and you'll get the idea.

We used an 80- to 68-pin adapter supplied by Seagate to test our ST973401LC. Our SCSI card was an LSI Logic LSIU160. That's a 160MBps unit, but it wouldn't hinder a single Ultra320 drive.

A glance at this drive's IOmeter File Server and Web Server scores underlines the reason SCSI still dominates in the server arena. IOmeter simulates multiple users and outstanding data requests to test a drive's ability to prioritize commands efficiently.

We rated the Savvio a 4.5 not because it could stack up against the 3.5-inch 15,000rpm drives in the following re-views, but because of how awesome it is for its form factor. The only drawback is that to get so much speed and space in such a small package, you'll pay one and a half times more to double what a 3.5-inch SCSI hard drive of the same capacity and higher spindle speed would cost you. ▲

by Marty Sems

How We Tested SCSI Hard Drives

PCMark04 1.2.0 with WMP 9 at default settings, NTFS drive, 16KB clusters; HD Tach 3 with 32MB zones, unpartitioned drive; IOmeter 2003.5.10, unpartitioned drive, File Server test at 1 user/16 outstanding I/Os, Web Server test at 4 users/ 64 total outstanding I/Os. Test PC: LSI Logic LSIU160 160MBps SCSI card, 2.8GHz P4 (LGA775/800MHz/1MB), 1GB Corsair PC4200 DDR2, GIGABYTE PCX 5900 128MB, ASUS P5AD2 Premium Wireless mainboard.

SCSI Hard Drive	
Seagate Savvio 73.4GB	
Final Word	A true 2.5-inch enterprise drive; expensive but revolutionary
Price	$730 online
Interface	Ultra320 SCSI
Spindle Speed (rpm)	10,000
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	3599
HD Tach 3	
Average Read (MBps)	54
Maximum Read (MBps)	62.5
Burst Read (MBps)	89.4
Random Access (ms)	7.4
Avg. Read Seek Time, Advertised (ms)	4.1
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	169.45
Web Server	231.84
For More Information	www.seagate.com
Overall Rating	

Maxtor Atlas 15K Ultra320 SCSI 73GB

The clear winner of our four-way head-to-head is Maxtor's Atlas 15K, model 8C073L0. It beat Hitachi's Ultrastar 15K73 and Seagate's Cheetah 15K.3 in IOmeter's File Server and Web Server tests, although less than 1IOps separated it from the Cheetah. Likewise, the Cheetah matched the Atlas for best random access time, 5.7ms, but the Maxtor pulled away with a thumpingly good PCMark04 score of 6320. The Atlas was less than 2MBps away from top rankings in average, maximum, and burst reads—actually less than 1MBps away from two of the three—but server tests speak most eloquently in a SCSI competition.

With the Atlas' specs mirroring its rivals' on paper, perhaps its MaxAdapt technology offers some explanation for its skill. MaxAdapt is Maxtor's architecture for adaptive active filtering, which adjusts signal amplitude in response to electrical conditions on the SCSI bus. Better signaling means less time wasted resending erroneous packets, so throughput benefits. There's probably also a little Maxtor hoodoo in the way the drive orchestrates its command queuing.

We tested the 68-pin version of this Atlas. There's also an 80-pin sibling but no Fibre Channel variant. With four platters whining at 15,000rpm, this Atlas is anything but quiet. It's rated at 34dB sitting idle, but the racket becomes a lot more than that when the drive is running a seek-intensive test. The smaller 18.4GB and 36.7GB Atlas 15Ks are quieter by 2dB and also have 0.2ms faster seeks.

All Atlas 15Ks have 8MB caches and can withstand a 250G 2ms shock when powered off. Their warranty period is five years. After this latest round of tests, we can't wait to try out the new Atlas 15K II, which has faster seeks and a 147.1GB top end. ▲

by Marty Sems

SCSI Hard Drive	
Maxtor Atlas 15K 73GB	
Final Word	The fastest server drive in our tests thus far; it flies
Price	$446 online
Interface	Ultra320 SCSI
Spindle Speed (rpm)	15,000
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	6320
HD Tach 3	
Average Read (MBps)	67
Maximum Read (MBps)	76.5
Burst Read (MBps)	96.1
Random Access (ms)	5.7
Avg. Read Seek Time, Advertised (ms)	3.4
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	317.16
Web Server	357.48
For More Information	www.maxtor.com
Overall Rating	

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Hitachi GST Ultrastar 15K73 Ultra320 SCSI 73.9GB

Although it looks incredible compared to lesser SCSI drives, not to mention any SATA or ATA drive you could name, the Ultrastar 15K73 has to step aside for the Maxtor and Seagate units in this section. Its two victories are slim, with a 1MBps or smaller margin in average and maximum reads. Those categories may hold a lot of water in the SATA and ATA arenas where single users are the norm, but they're less important than random access times and multiuser/command benchmarks in the server realm.

This Hitachi comes in a three-disk, 36.9GB or five-disk, 73.9GB edition. Interface options are typical, including 68-pin or 80-pin Ultra320 SCSI, plus 200MBps FC-AL. Our 80-pin test sample was model HUS157373EL3800 and DK32EK-72NC, reflecting both IBM and Hitachi GST influences. We've also found it listed as 08K2403 online.

We used a Seagate 68-pin to 80-pin adapter to test this drive. The 73.9GB model's noise is significant, underscoring its 37dB acoustic rating when idle. Despite hanging tight with the Atlas 15K and Cheetah 15K.3 in sequential read tests, the Ultrastar's slower seek and access times hobbled it in benchmarks designed to imitate productivity and server usage patterns. This meant noticeable deltas among this Hitachi and its rivals in both IOmeter tests. PCMark04, even more critical, seemingly called the Ultrastar about 30% slower than the winning Maxtor.

The Ultrastar 15K73 has AFC recording media, FDB bearings, and a 250G shock tolerance (2ms, nonoperating). We wouldn't kick it out of bed for eating crackers, but we probably wouldn't go asking it to the prom, either. ▲

SCSI Hard Drive	
Hitachi GST Ultrastar 15K73 73.9GB	
Final Word	Great sequential performance, but slacks a bit in server aptitude
Price	$379 online
Interface	Ultra320 SCSI
Spindle Speed (rpm)	15,037
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	4396
HD Tach 3	
Average Read (MBps)	67.8
Maximum Read (MBps)	78
Burst Read (MBps)	95.9
Random Access (ms)	6.1
Avg. Read Seek Time, Advertised (ms)	3.9
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	273.94
Web Server	324.28
For More Information	www.hitachigst.com
Overall Rating	

by Marty Sems

Seagate Cheetah 15K.3 Ultra320 SCSI 18.4GB

Seagate's line of rip-snorting Cheetah 15K.3 drives includes 18GB, 36GB, and 73GB capacities, and we tested the runt of the litter. Small it may be by today's standards, but the interesting fact was that we could buy this 15,000rpm drive for about $115. At that price, we're tempted to throw it in a PC with a $33 adapter card for a few games and a swap file. A 73GB Cheetah 15K.3 would cost approximately $439 online, in case you're comparing notes with the preceding two drive reviews.

The Cheetah 15K.3 family covers the usual bases of 2Gbps (effectively 200MBps) FC-AL, Ultra320 68-pin, and Ultra320 80-pin interfaces. The lineup uses fluid dynamic bearings, of course, and carries 8MB caches.

Despite the range of capacities in the bunch, each 15K.3 has a 250G shock tolerance (2ms, nonoperating) and a 3.6ms seek time across the board.

Our Cheetah, model number ST318453LW, was a 68-pin SCSI unit with one hard drive inside. It has a bit of that big-cat purr to it, starting at 31dB when idle. That purr becomes a 35dB yowl in the 73GB littermate.

In our tests, our Cheetah shared the random access win with Maxtor's Atlas 15K and came within a whisker of winning IOmeter's Web Server test. It beat the rest of the pride in burst reads yet stalked just behind the winners' tails in most other categories.

Seagate gives this Cheetah an estimated 1.2 million MTBF. If you're a fan of the big kitty, keep your nose to the wind for the scent of the forthcoming Cheetah 15K.4. It's going to have a 1.4 million hour MTBF and come in varieties up to 147GB. ▲

SCSI Hard Drive	
Seagate Cheetah 15K.3 18.4GB	
Final Word	Hmm, $150 for a brutal game/app drive and SCSI card? Score
Price	$115 online
Interface	Ultra320 SCSI
Spindle Speed (rpm)	15,000
Cache Buffer (MB)	8
PCMark04 1.2.0	
Hard Drive	5404
HD Tach 3	
Average Read (MBps)	66.2
Maximum Read (MBps)	77
Burst Read (MBps)	96.8
Random Access (ms)	5.7
Avg. Read Seek Time, Advertised (ms)	3.6
IOmeter 2003.5.10 (inputs/outputs per second)	
File Server	299.66
Web Server	356.73
For More Information	www.seagate.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless, 2.5 = Absolutely Average, 5 = Absolutely Perfect

Tech White Paper:

Intel Matrix RAID

RAIDs 0 & 1 Together On Just Two SATA Drives

Desktop PC users need more RAID options. That's all there is to it.

RAIDs 0 and 1 support comes standard on most enthusiast motherboards, and they're cheap to implement because they only require two hard drives. RAID 0 stripes your data, or splits it between two or more drives, to speed up reads and writes. RAID 1, by contrast, saves a full copy of every file on two or more drives for instantaneous backup. On the downside, RAID 0's nonredundant nature puts your data at higher risk of loss, and RAID 1 spends half of your drive space on backup copies. And if you want a combination of RAID 0's speed and RAID 1's redundancy, you'll need to buy even more hard drives and possibly a controller card to access other forms of RAID.

Intel's new Matrix RAID tries to give users the best of both worlds without the annoyances. Matrix RAID lets you create two RAID 0 and/or 1 volumes on just one pair of hard drives. For example, you could make a RAID 1 volume on the first two-thirds of your drive pair, or array, to keep Windows and your personal data continually backed up. The remaining space on your two-drive array could become a RAID 0 volume. After you install your apps and games on it, and set your paging file and audiovisual editing apps to use that RAID 0 space as temporary work areas, your system should read and write this data at much better speeds.

In this white paper, we'll explore Intel's Matrix RAID in a little more detail. Don't confuse Matrix RAID with Intel's Matrix Storage Technology, by the way. Matrix Storage Technology is Intel's umbrella term for a host of hard drive technologies, such as AHCI (advanced host controller interface), NCQ (native command queuing), Matrix RAID, and regular RAIDs such as 0, 1, and JBOD (just a bunch of drives). However, only a handful of chipsets—namely those with Intel's ICH6R controller hub, or southbridge—actually support Matrix RAID.

Whys & Wherefores

Although the ability to have multiple RAID volumes on a single array has existed for years in the enterprise server realm, Intel decided that the market conditions were now auspicious to bring the technology to the desktop. Shan Hemphill, a software product marketing engineer at Intel, says that the company's desktop division enlisted the help of its storage division to make Matrix RAID a reality. Key to this development was some intellectual property from Intel's acquisition of a company that had worked in enterprise RAID.

Some users decry speed-enhancing types of RAIDs because these arrays may not make much difference in the applications they use most. For instance, a RAID 0 will load game levels faster than a single drive or RAID 1, but it won't give you higher frame rates once you're actually playing. Others avoid RAID 1 because it wastes so much drive space and doesn't safeguard data if the PC is stolen or lost in a disaster. On the other hand, many enthusiasts would enthusiastically embrace the option to use both types of RAID in one PC. They realize that a RAID 0 can shuttle files and load apps much faster than can a single drive, and that in most cases, RAID 1's immediate mirroring of data can spare them the pain of re-creating data lost since the last backup.

Enter The Matrix

We'll spare you any cheap Laurence Fishburne quotes about taking a blue pill to leave Hollywood's Matrix, but you do need the right hardware from the home of the Blue Men to get into Matrix RAID.

First of all, you will need a motherboard with an Intel ICH6R (82801FR) I/O controller hub. You'll typically find the ICH6R on certain SATA RAID-capable boards that use Intel's 915P or 925X chipset. Matrix RAID won't work on a plain ICH6. Again, don't let the more lax requirements for Matrix Storage Technology listed on Intel's site confuse you.

Next, you'll need two SATA hard drives—no more, no fewer. Hemphill says that any SATA drive will do. However, the newest generation of SATA drives with NCQ, such as Seagate's latest Barracuda 7200.7 and Maxtor's DiamondMax 10, will get up to a 21% speed boost when controlled by the ICH6R. Because NCQ efficiently prioritizes multiple outstanding data read and write commands to the drive, it naturally complements the Hyperthreading feature built into recent Intel Pentium 4s to run several discrete processes (threads) at once. NCQ also seems to become more efficient as drives grow more fragmented, Hemphill says. He adds that Intel did work on extending Matrix RAID to PATA (EIDE) drives but dropped the project because demand seemed low.

As for software, you should use the latest versions of the IAA (Intel Application Accelerator) RAID Edition and Intel Chipset Software Installation Utility. Matrix RAID only works under Windows 2000/XP, although there's a driver available at iswraid.sourceforge.net in case you want to dual-boot to Linux. Finally, you'll need to create a driver diskette to use as you're installing Windows later.

The build. We built a Matrix RAID system of our own, using two non-NCQ Western Digital WD2500JD SATA hard drives. Our motherboard was an ASUS P5AD2 Premium Wireless Edition, which is an LGA775 board bearing Intel's 925X and ICH6R chipset. We assembled the rest of our new system with a 775-pin, 2.8GHz Pentium 4 (800MHz FSB/1MB L2 cache); a PCI Express Gigabyte PCX 5900 graphics card; and 1GB of 240-pin, PC4200 Corsair DDR2.

We used an auxiliary PC to find the F6flpy32.exe driver floppy creator utility on our ASUS board's installation CD. The utility file was in the chipset driver section of the disc in the IAA folder. We launched F6flpy32.exe and made the driver diskette as directed.

Next, we started the PC for the first time, pressing DELETE to head immediately into the BIOS Setup utility. Here, we changed the IDE Configuration section's Configure SATA As setting to RAID, then the Onboard Serial ATA BootROM field to Enabled. We exited Setup, saving our changes.

After a reboot, we pressed CTRL-I to enter the Intel Application Accelerator RAID Option ROM settings. Here, we created and named our first RAID volume, a RAID 0. We accepted the default Strip Size of 128KB and set the volume's capacity to about 100GB. Had we accepted the default full capacity, there wouldn't have been room for our second RAID volume.

After completing the 100GB RAID 0, we went back through Create Volume again, this time making a RAID 1 for data redundancy. The utility automatically assumed we wanted to use the remainder of the hard drive space, approximately 364GB, for this volume. Instead of a 500GB total capacity, we had a 100GB OS and applications volume and a 182GB volume for data (half of 364GB), making 282GB of total storage space on the PC.

Note that Matrix RAID only allows you to make two volumes. However, you can make those two volumes any combination of RAIDs 0 and 1, including mildly pointless combos such as two RAID 0s or two RAID 1s. We inserted the WinXP installation CD-ROM and then exited the Intel Application Accelerator RAID Option ROM utility.

Following a reboot, WinXP's Setup asked us to press F6 to install SCSI or RAID drivers. We inserted the Intel driver diskette we'd made, then followed the on-screen directions until such time as we could choose the Intel 82801FR SATA RAID Controller driver (82801FR is another name for the ICH6R controller hub). We had four drivers with similar names from which to choose, so we took care to install the right one.

When Setup asked us for the partition on which we would like to install

Benchmarks

We followed our own muse and built a Matrix RAID a little differently than Intel's example. We put Windows XP Professional Service Pack 2, our apps, and our games—anything with installation CDs—on the initial RAID 0 volume, leaving the RAID 1 volume for data. Our hard drives were 250GB SATA Western Digital WD2500JDs. The PC had a 775-pin, 2.8GHz Pentium 4 (800MHz FSB/1MB L2 cache); an ASUS P5AD2 Premium Wireless Edition motherboard with the ICH6R controller hub; a PCI Express Gigabyte PCX 5900 graphics card; and 1GB of 240-pin, PC4200 Corsair DDR2. We ran PCMark04 (version 1.2.0, with Windows Media Player 9) and 3DMark03 (build 340, with DirectX 9.0c) at default settings; HD Tach 3 with 32MB zones; IOmeter 2003.5.10's File Server test at one user, 16 outstanding I/Os; IOmeter's Web Server test at four users, 64 total outstanding I/Os.

Benchmark	Matrix RAID 0 & 1
3DMark03 Build 340	4838
3DMark05 1.0.0	863 (617 at 4XAA)
PCMark04 1.2.0	4127
CPU	4187
Memory	4892
Graphics	3648
HDD	5634
Halo (frames per second)	
800 x 600	40.19
1,024 x 768	36.7
1,280 x 1,024	28.1
Doom 3 (frames per second)	
800 x 600	37.3
1,024 x 768	29.7
1,280 x 1,024	21.1
HD Tach 3	
Average read (MBps)	56.2
Maximum read (MBps)	69
Burst read (MBps)	145
Random access (ms)	10.2
IOmeter (inputs/outputs per second)	
File server	189.5
Web server	237.46

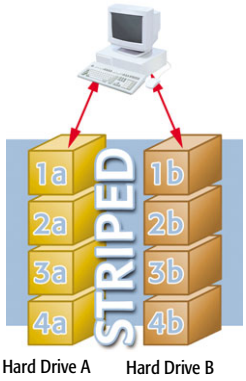
RAID Comparisons

RAID Type	Number of Drives	Total Capacity*	Benefits	Drawbacks
0	2 or more	100% of both drives	Provides terrific speed	Poses a higher risk of data loss if one drive fails
1	2 or more	50% of both drives	Offers 1:1 data redundancy; makes it easy to rebuild after a drive failure	Cuts total storage space in half; offers the speed of a single drive
Matrix RAID	2	100% of RAID 0 volume plus 50% of RAID 1 volume	Provides flexibility when it comes to speeding up apps while keeping personal data safe; offers many of RAID 0+1's benefits using half the number of drives	Currently only available for SATA drives on certain mobos with an Intel ICH6R controller

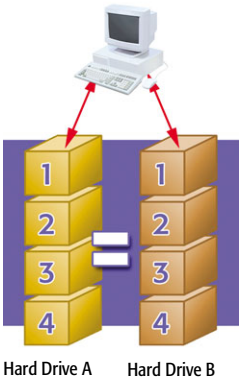
*Assuming hard drives are of equal size.

The Matrix Compared

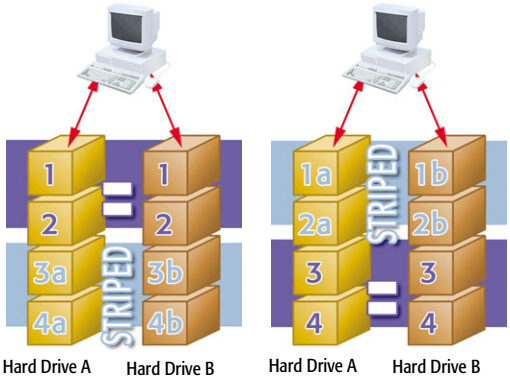
Single-drive PC: A computer with one hard drive stores data like this, one chunk after another.



RAID 0: With RAID 0, the computer stripes (divides) data over two drives for much greater speed. However, there's a higher risk of data loss if either drive fails.



RAID 1: A RAID 1 writes the same data to two hard drives for immediate backup. Unfortunately, this redundancy cuts storage space in half and adds no speed.



Matrix RAID: Matrix RAID lets users create both types of RAIDs on a single pair of hard drives. This lets users choose the appropriate level of speed and risk for different types of data.

WinXP, we first took the opportunity to set up NTFS partitions on both volumes. Matrix RAID will let you partition each volume normally; that is to say, with as many drive letters as Win2000 or WinXP will allow. For example, you might want to split the initial array into a 10GB partition for your OS and a 90GB partition for your apps and games to make future OS reinstallations less traumatic. WinXP Setup formatted the designated OS partition, but we had to remember to format the RAID 1 volume in Windows later on.

The rest of our WinXP installation and updating went smoothly enough, thanks to the RAID 0 volume's speedy data handling. Benchmark scores from the completed system are listed in the "Benchmarks" sidebar.

Conversion. If your PC has the right hardware and software, you can also convert an existing single-drive installation into a Matrix RAID. The way to do this in IAA Storage Utility 4.1 is to click Create RAID Volume From Existing Hard Drive in the Actions menu. However, says Hemphill, "you're limited in the circumstances in which you can trade space up." In other words, it's important which type of RAID you make first in the new Matrix RAID.

As an example, he says, turning a 120GB single drive into a mirrored RAID 1 with a second 120GB drive would absorb all the space on both drives, leaving no room for a second RAID 0 volume on the Matrix array. "I would have to start from the 120GB drive, stripe it—so, migrate to RAID 0 (by adding the second drive)—and then I would have another 120GB that I could do mirroring (RAID 1) on." Keep in mind that, as with most integrated RAID controllers, the ICH6 will ignore the extra space if one Matrix RAID drive is bigger than the other.

A Smooth Double-RAID Blend

With Matrix RAID, your PC will likely be somewhat faster than with non-RAID drives or a single hard disk. How much faster depends on how you set up the two types of RAID, 0 and 1, and where you install your OS, apps, and games.

If you put all three of these on an initial RAID 0, leaving a subsequent RAID 1 for data, you might expect roughly double the hard drive speed of a single-drive system, except when saving or loading personal data files. This showed itself in our system, especially in the PCMark04 and IOmeter benchmarks. On the other hand, if you build a RAID 1 first for the OS and your data, and a secondary RAID 0 for apps, games, a swap file, and audio/video work files, your PC's speed will fall somewhere between a single-drive system and the first example. Remember, you'll only notice faster speeds when you're loading something from or saving something to the RAID 1 volume.

Probably the most exciting news about Matrix RAID is that you may not long be limited to Intel controller hubs to get it. Hemphill says that other RAID controller manufacturers may not even have to license the technology from Intel before offering products that are at least functionally equivalent.

"Really, they wouldn't need our permission," he says. "Multiple volumes per RAID has actually been around in the industry for a while. . . . They could go implement that today. There is specific intellectual property that Intel has in our product, but we don't have anything specific to what we're calling Matrix RAID that's protected." CPU

by Marty Sems

Sony DRU-710A

Verbatim rep Andy Marken explains that trying to push 8X media past 12X or so rarely works with today's discs. Using Nero 6.3.1.25 (and also Roxio 6.1.1.48) and all updates, and the latest firmware as of this writing, our Sony DRU-710A steadfastly refused to see Memorex, Verbatim, Taiyo Yuden, TDK, Plextor, or a mystery 8X disc as anything but 8X candidates.

The Sony worked very well with a Verbatim 16X—special thanks to Verbatim for these particular discs—writing 4GB at 16X in 8:53. On the other hand, a Philips 16X DVD+R looked like an 8X to the DRU-710A. Still, that 9:52 burn time on the Philips 16X at 8X is better than some of the 16X times that other drives logged.

The drive would only recognize a Ritek 48X and a Verbatim 52X CD-R as 40X, at least until we disabled the CD speed cap. Also, just like our Sony DRU-700A, the DRU-710A would only offer to burn a Verbatim 32X CD-RW at 16X. A Samsung disc worked at 24X, however.

The Sony really shone at DVD+RW and DVD-RW writes, completing burns three minutes faster than most of its competitors in this section. It also looked great in CD reads. Our test system had an Athlon 64 2800+, 512MB of OCZ Gold PC4400 DDR (at PC3200), an Epox EP-8HDA3+ mobo, a Maxtor DiamondMax Plus 9 80GB SATA drive, and Windows XP Professional SP2.

If you're an RW-burnin' fool and don't mind hunting for compatible discs, keep the DRU-710A in mind. Its oft-extended $30 rebate may still be in effect when you read this. ▲

Rewritable DVD	
Product (firmware)	Sony DRU-710A (BY01)
Final Word	Great DVD±RW times, but some compatibility gotchas
Price	$134 retail ($104 after rebate)
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite/Read speeds (DVD 1X= 1.35MBps; CD 1X= 0.15MBps)	16X/4X/16X DVD+RW, 8X/4X/16X DVD-RW, 48X/24X/48X CD-RW, \2.4X DVD+R DL
Buffer size	2MB
OS support	Win2000/XP
Disc formats supported	8.5GB DVD+R DL, CD-Text, CD+G, etc.
Testing	
Read Speed, Average	34.82X CD, 5.93X DVD
Random Access (in ms)	120ms CD, 120ms DVD
For More Information	www.sonyburners.com
Overall Rating	

by Marty Sems

BenQ DW1620

When Acer Peripherals changed their name a few winters ago, the new name was pronounced "Benk." Of course, the company didn't capitalize the Q at that point, and I've heard that some reps insist that the name is now spoken as "Ben-queue."

The company endowed its recent DW1620 with several technologies for optimized control of the write laser's power and tilt angle across the entire disc, as well as a Sliding Cone Mechanism on the spindle for better access times and fewer errors. BenQ included a 16X DVD+R disc in the re-tail box, bless their buttons. Nero recognized this fact immediately, giving us 16X and 12X alternatives to the 8X ceiling against which we'd been butting our heads. However, the drive didn't complete its 16X disc until 11:43 had elapsed. That was slower than the Plextor PX-721SA's 8:48 write at 12X, and even pokier than the Sony DRU-710A's 9:52 burn at 8X.

Furthermore, we didn't have a 12X DVD-R with which to try the drive, and the DW1620 treated our Memorex 8X as just that. However, the BenQ did write our Verbatim 32X CD-RW at 24X, whereas our Sonys only saw it as 16X.

Overall, the BenQ was a competent burner, though generally one a few paces behind the others. It did top our rankings in DVD-ROM read speeds, though.

The DW1620's retail software bundle includes a book type management utility, so you can set the book type bit of a DVD+R/RW to DVD-ROM for broader playback compatibility. There's also Sonic RecordNow, InterVideo WinCinema, and BenQ QVideo 2.0. ▲

Rewritable DVD	
Product (firmware)	BenQ DW1620 (B7C9)
Final Word	Fast DVD reads, but pokey elsewhere; a decent choice for the price
Price	$80 retail
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite/Read speeds (DVD 1X= 1.35MBps; CD 1X= 0.15MBps)	16X/4X/16X DVD+RW, 12X/4X/16X DVD-RW, 40X/24X/40X CD-RW, 2.4X DVD+R DL
Buffer size	2MB
OS support	Wind98SE/Me2000/XP
Disc formats supported	8.5GB DVD+R DL, CD-Text, Bootable CD, SVCD, etc.
Testing	
Read Speed, Average	29.33X CD, 9.24X DVD
Random Access (in ms)	110ms CD, 104ms DVD
For More Information	www.benq.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

NEC ND-3500A

NEC's remarkable ND-3500A not only has 16X write capabilities in both DVD+R and DVD-R, but also a 4X rating in DVD+R DL. The bigger story, however, is that the NEC burned a 2.4X Verbatim DVD+R DL at 4X speed, with a write time of 47:42. That's great news for attracting more users to this spacious, 8.5GB format.

We couldn't find 16X or even 12X DVD-R media by print time, but the NEC's 8X burn in 11:33 outpaced the similar Pioneer DVR-108BK's 12:19 write at 12X. This is the second time we've witnessed a slower theoretical burn rate producing a faster disc, so we don't subscribe too much to the worship of Xs for Xs' sakes.

That 11:33 write took first place in the DVD-R competition. The ND-3500A's 3:05 Ritek CD-R was a winner, as well. The drive's 9:11 DVD+R result was merely competitive, however, but its 47:42 DVD+R DL time was only 21 seconds off the leader.

This NEC differs only a little, specswise, from the Pioneer. The delta in CD-RW ratings showed in the two drives' 3:05 and 4:25 respective CD-R times. The ND-3500A did write our 32X Verbatim CD-RW at 24X, as did the Pioneer.

Our bare drive came without the Nero Express 6-based bundle of the retail version. We didn't encounter any failures of any kind.

In the end, NEC's ND-3500A is a paragon of media compatibility. The downside is that NEC generally white-labels its drives for OEMs and does not currently provide any firmware updates for its burners. That's pretty much the only qualm we have about recommending this drive, at least in NEC trim. ▲

Rewritable DVD	
Product (firmware)	NEC ND-3500A (2.16)
Final Word	Outstanding compatibility and competitive speed; lack of firmware support, though
Price	$79 OEM
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite /Read speeds (DVD 1X=1.35MBps; CD 1X= 0.15MBps)	16X/4X/16X DVD+RW, 16X/4X/16X DVD-RW, 48X/24X/48X CD-RW, 4X DVD+R DL
Buffer Size	2MB
OS Support	Win98SE/Me2000/XP
Disc Formats Supported	8.5GB DVD+R DL, CD-Text, CD-Bridge, etc.
Testing	
Read Speed, Average	33.69X CD, 7.12X DVD
Random Access (in ms)	124ms CD, 125ms DVD
For More Information	www.nec.co.uk DVD_RW_ND3500.aspx
Overall Rating	

by Marty Sems

PIONEER DVR-108BK

Like the 4X and 8X discs of months past, blank 16X DVD+Rs are rare, and 16X DVD-Rs are practically nonexistent in a retail sense. It's easier to make faster drives than media that can be reliably burned at those higher speeds. The big question after DVDs get promoted to a new level of write speed—in this summer's case, 16X—is whether a drive can burn discs beyond their 8X ratings.

Like the NEC ND-3500A, Pioneer's DVR-108BK is rated for 16X DVD±Rs and 4X DVD+R DLs. But here's a new one: The DVR-108BK refused to write anything on our 16X Verbatim DVD+R past 12X speed, yet it burned a Memorex 8X at 16X speed. And it did write our 2.4X Memorex DVD+R DL disc at 4X. Go figure.

That 4X DVD+R ejected after just 47:21, edging out the NEC drive for the double-layer championship. Regular DVD+Rs seemed to take the Pioneer longer than the other drives, though. Still, the rest of the DVR-108BK's burn times were in the running, and the drive did hit a higher max DVD read speed than the rest. It also allowed us to burn our 32X Verbatim CD-RW at 24X rather than 16X.

Pioneer lists a handful of tricks the DVR-108BK uses on the company's Web site. From noise and vibration reduction to accommodations for media that isn't perfectly flat, Pioneer has a technology to address the problem. The DVR-108BK also purports to keep RW media fresh throughout repeated reuse.

This Pioneer has some speed to it, but its broad compatibility and quality impress us more. If you can't locate an NEC ND-3500A, buy this drive. ▲

Rewritable DVD	
Product (firmware)	Pioneer DVR-108BK (1.14)
Final Word	8.5GB DL write speed, and not bad at everything else
Price	$84 OEM
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite /Read speeds (DVD 1X=1.35MBps; CD 1X= 0.15MBps)	16X/4X/16X DVD+RW, 16X/4X/16X DVD-RW, 32X/24X/40X CD-RW, 4X DVD+R DL
Buffer Size	2MB
OS Support	Win98SE/Me2000/XP
Disc Formats Supported	8.5GB DVD+R DL, CD-Text, etc.
Testing	
Read Speed, Average	30.49X CD, 6.53X DVD
Random Access (in ms)	134ms CD, 136ms DVD
For More Information	www.pioneerelectronics.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless, 2.5 = Absolutely Average, 5 = Absolutely Perfect

PLEXTOR PX-712SA

Plextor took its time bringing a 16X DVD burner—or even a double-layer drive—to the table. The company's representatives told us that Plextor wanted to get its long-awaited PX-716 right the first time. That's why the PX-712A held such a surprise for us.

No, the SATA interface didn't catch us unawares. We knew about the drives' unique status as the first SATA optical drive before we bought it. There's no Molex 4-pin power jack, so you may need to use the Molex-to-SATA power adapter Plextor provides. SATA doesn't give this drive any more speed than EIDE/ATAPI, as ATA/33 is plenty fast for even 16X DVD burns. However, SATA has other qualities to recommend it, and that thin data cable helps keep your case tidy.

Anyway, what did surprise us was the fact that the Plextor failed near the end of two separate 4GB burns on Memorex 8X DVD-R media. As with the other drives in this section, we had installed the latest firmware. The PX-712SA isn't brand new, so this failure is a puzzle considering the amount of time Plextor has had to tweak media compatibility.

The Plextor does have free phone tech support. And it gave us top DVD access times, not to mention the fastest DVD+R (8:48) and CD-RW (3:38) burns. Among its many technical innovations, well-documented elsewhere, the PX-712SA limits CD speed against breakage and DVD speed for acoustic reasons. We circumvented both speed caps in our tests, as we did for all of our drives.

The 12X, non-DL PX-712SA is a fairly good drive, but we'll wait to see how the PX-716 fares in our tests before we recommend a new Plextor. ▲

Rewritable DVD	
Product (firmware)	Plextor PX-712SA (1.05)
Final Word	A serial ATA optical drive; free phone tech support; great DVD+R speeds; spotty compatibility
Price	$134 retail
Features	
Internal/External	Internal
Interface	SATA
Write/Rewrite /Read speeds (DVD 1X= 1.35MBps; CD 1X=0.15MBps)	12X/4X/16X DVD+RW, 8X/4X/16X DVD-RW, 48X/24X/48X CD-RW
Buffer Size	8MB
OS Support	Win2000/XP (Win98SE/Me/2000/XP for PX-712A)
Disc Formats supported	Mt. Rainier CD-MRW, CD-Text, DVD±VR, etc.
Testing	
Read Speed, Average	33.75X CD, 5.23X DVD
Random Access (in ms)	110ms CD, 91ms DVD
For More Information	www.plextor.com
Overall Rating	

by Marty Sems

SONY DRU-700A

As a last-minute replacement for the new Samsung TS-H552B, an incorrect version of which was snatched from our hands before we could run any tests, the aging Sony DRU-700A takes center stage. It's an 8X DVD±R burner and a 12X DVD reader, unlike the 16X DVD+R-capable DRU-710A reviewed earlier in this section. The DRU-700A also gives up a little in CD-R writes and reads, at 40X/24X/40X. (Sony's DRU-5xx series doesn't offer double-layer 8.5GB writing, so it's worth your while to stick to the DRU-7xx series or other DL drives.)

As expected, this slightly older Sony didn't set many records in our tests. Nor was it far behind in any category. It did win the CD random access time contest, for what it's worth. The DRU-700A shouldn't let you down in day-to-day use, but it's not the name to drop if you're looking to impress anybody with that list of hardware in your forum signature line.

Like its brother drive, the DRU-700A throttled our Verbatim 32X CD-RW down to 16X instead of 24X, but by now we're calling that a Sony tradition. Also like the DRU-710A, it has a $30 rebate at this writing. That means a $119 final price, or $69 if you find it at the $99 OEM price online. That places the bare DRU-700A $10 to $15 under the best drives in this section, but you'd probably have to forgo Nero and the black replacement bezel in the retail box.

Drive Watch: In the newer DVD ranks are the Toshiba SD-R5327, which claims 5X DVD+R DL burns; Plextor's PX-716, the company's first DL drive (4X); and LG's GSA-4160B, which can write *everything* DVD thus far, including DL and DVD-RAM. Stay tuned. ▲

Rewritable DVD	
Product (firmware)	Sony DRU-700A (VY06E)
Final Word	OK speeds; the $99 bare version is a good value after rebate
Price	$149 retail ($119 after rebate)
Features	
Internal/External	Internal
Interface	EIDE/ATAPI
Write/Rewrite /Read speeds (DVD 1X= 1.35MBps; CD 1X=0.15MBps)	8X/4X/12X DVD+RW, 40X/24X/40X CD-RW, 2.4X DVD+R DL
Buffer Size	2MB
OS Support	Win2000/XP
Disc Formats Supported	8.5GB DL DVD+R, DVD±R/RW, CD-R/RW, CD-Text, etc.
Testing	
Read Speed, Average	29.21X CD, 6.72X DVD
Random Access (in ms)	103ms CD, 120ms DVD
For More Information	www.sonyburners.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Optorite CW5201

Driving costs down is low-buck leader Optorite of Taiwan. Its CW5201 boasts a 32X CD-RW burn speed, plus 52X ROM reads and R writes. Those speeds are at the top of the writable CD game. The drive has a 2MB buffer backed up by Sanyo's Burn-Proof buffer underrun technology, both par for the course. Optorite also claims a recording quality safeguard dubbed Exact-Rec, as well as a vibration and noise reduction feature called AWSS. As for the latter, any mechanism to help cut the noise of a 52X drive reading at full bore is appreciated, although any imperfections in a disc may compound the din and defeat AWSS's efforts.

We prepped the Optorite as the master drive on the second EIDE channel on our Athlon 64 2800+ test system, which we used throughout the CD-RW review section of this issue. The PC also packed 512MB of OCZ Gold PC4400 DDR, an Epox EP-8HDA3+ mainboard, an 80GB Maxtor 6Y080M0 SATA hard drive, and WinXP Pro with SP2.

The CW5201's CD-R and CD-RW burn times were within spitting distance of each other at 3:14 (minutes:seconds) for a 700MB CD-R and 3:17 for a 639MB CD-RW. That CD-R was almost a minute slower than the best we've seen, but the CD-RW makes up for it with perhaps the fastest burn we've witnessed. Rounding out the speed tests were higher-than-average CD-ROM read rates and access times right in line with our expectations.

At just 25 bucks, the Optorite didn't come with an ATA cable. However, it did come with an analog audio cable, mounting screws, and Nero 5.5.10.7. Seriously, at this price, you can't go wrong. ▲

CD-RW	
Product (firmware version)	Optorite CW5201 52X/32X/52X CD-RW (220E)
Final Word	Super-brisk CD-RW writing and great CD-ROM reads, and just look at that price
Price	$25
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite /Read speeds (CD 1X=0.15MBps; DVD 1X=1.35MBps)	52X/32X/52X CD
Buffer Size	2MB
OS Support	Win95/98/Me/2000/XP
CD Formats Supported	Video CD, CD-Text, bootable CD, etc.
Testing	
Read Speed, Average	34.68X CD
Read Speed, Maximum	46.51X CD
For More Information	www.optorite.com
Overall Rating	cpu cpu cpu

by Marty Sems

Plextor Premium 52X/32X/52X

The most interesting features to typical users are the special recording modes. GigaRec allows you to cram up to 913MB on a typical CD-R, whereas SecuRec lets you password-protect a disc. For us, GigaRec discs had spotty compatibility with non-Plextor drives and players.

Plextor also pioneered the anti-jitter black disc tray, now being emulated by the likes of Sony. Other features offer advanced users the chance to examine written discs for various error types, as well as to tweak the writing laser's power setting for best compatibility with all the devices that will read the resulting discs.

Plextor endowed the Premium with an 8MB cache buffer, as well as a 40X default read cap to avoid unpleasantness such as unbalanced pressed discs flying into bits. The 40X governor can be disabled in software or by pressing the eject button for a few seconds before inserting a CD.

Our fully updated Premium choked out a 700MB CD-R in 3:49 and a 639MB CD-R in 3:38. We wrote those discs using the drive's default PoweRec setting, which monitors recording quality. The Premium also turned in average reads of 28.92X and a maximum of 41.05X (33.28X and 49.5X without the 40X cap). Access times were nice and tight, and digital audio extraction went off without a hitch. Several times, however, the Premium errored out in our Nero CD Speed 3.21 tests.

The Premium's chunky software bundle includes Roxio 6.1.1.48 and assorted Plextor utilities. Also included in that formidable price is Plextor's famed unlimited, toll-free tech support at (800) 886-3935. ▲

CD-RW	
Product (firmware version)	Plextor Premium 52X/32X/52X CD-RW (1.05)
Final Word	Nifty features, additional software, and toll-free phone support factor into that price
Price	$83
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite /Read speeds (CD 1X=0.15MBps; DVD 1X=1.35MBps)	52X/32X/52X CD
Buffer Size	8MB
OS Support	Win98/Me/2000/XP
CD Formats Supported	GigaRec, SecuRec, Mt. Rainier, CD-Text, etc.
Testing	
Read Speed, Average	28.92X CD (33.28X CD w/out 40X cap)
Random Access (in ms)	89ms CD
For More Information	www.plextor.com
Overall Rating	cpu cpu cpu cpu

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless cpu cpu 2.5 = Absolutely Average cpu cpu cpu cpu cpu 5 = Absolutely Perfect

Samsung SM-352B

Today, it's a much smarter move to spend another $30 and get a full-fledged DVD burner. Here's a last glimpse at combo drives' glory days, courtesy of the company that kept combos on the map.

Samsung's SM-352B covers the top read rates for CDs and DVDs, as well as the peak write rates in the CD-R and CD-RW kingdom. It has an 8MB buffer, unlike the later SM-352F and SM-352N variants still listed on Samsung's site (both with 2MB caches).

Our bare Samsung didn't come with any software, so we borrowed the Roxio 6.1.1.48 installation and updated drive tables from our Plextor Premium. The SM-352B didn't like our Verbatim 32X CD-RWs in either Roxio or Nero, though, restricting them to 4X speed. The drive reported its firmware version as T807, although Samsung's site told us that T806 was the latest available. We tried rolling the drive back to T806, but even that version proved elusive when we couldn't reach Samsung's server.

We used a 24X Samsung disc for our 639MB CD-RW test, resulting in a 4:15 time. The drive also made a 700MB CD-R in 3:13. The Samsung read a CD-ROM at close to its advertised speeds but only managed about half its spec on DVD-ROM reads.

The drive couldn't read a DL (double-layer) DVD+R, which was no surprise. On the other hand, the SM-352B could access a Memorex 4X DVD+R and a Verbatim 2.4X DVD+RW, despite the omission of DVD+R/RW from the drive's supported media list. Still, sub-$80 DL drives have finally sounded this combo drive's death knell. ▲

DVD-ROM	
Product (firmware version)	Samsung SM-352B (T807)
Final Word	Good in its day, but a low-end DL (double-layer) drive will serve you better
Price	$45
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite/Read speeds (CD 1X= 0.15MBps; DVD 1X=1.35MBps)	52X/32X/52X CD-RW 16X DVD-ROM
Buffer Size	8MB
OS Support	Win98/Me/2000/XP
Disc Formats Supported	DVD-R/RW (read), DVD-RAM (read), Mt. Rainier, DVD+R/RW (read, as tested)
Testing	
Read Speed, Average	34.81X CD, 5.98X DVD
Random Access (in ms)	124ms CD, 152ms DVD
For More Information	www.samsung.com
Overall Rating	

by Marty Sems

Lite-On SOHC-5232K

Lite-On gave its SOHC-5232K combo the same specs as Samsung's SM-352B, yet the former drive was significantly faster in our tests. Nor did the Lite-On balk at our Ver-batim 32X media. Using the latest firmware as of this writing, the Lite-On even read an 8.5GB DVD+R DL.

Besides the buffer underrun protection for its 2MB cache—Smart-Burn in this case—the SOHC-5232K boasted Lite-On's VAS vibration reduction and Smart-X data extraction monitoring features. The drive simply did not give us any guff throughout our testing procedures, which was refreshing, actually.

Lite-On's strong suit is reading data. It could meet or beat anything our Samsung drive did, and it was more often beat than meet. The 3:15 burn time for a 700MB CD-R and a 4:06 elapsed time for a 639MB CD-RW fit in well with the rest of the CD-RW pack. The noncombo models in this section fared better at writing CD-RW discs in a hurry, but the combos' ability to read DVDs is more important, we think.

Our boxed Lite-On came with all the extras that our bare Samsung didn't. These included screws, an analog audio cable, and a blank CD-R. More importantly, there was Nero Express 5.5.10.53 for burning CDs and CyberLink PowerDVD 5 for playing our new "Star Wars" DVDs.

At just $41 online, Lite-On's SOHC-5232K handily beats Samsung's SM-352B combo, although both pale before any DL DVD burner in the sub-$100 range. Still, with very decent performance in its intended uses, this Lite-On may still have a definite niche. ▲

DVD-ROM	
Product (firmware version)	Lite-On SOHC-5232K (NK0A)
Final Word	Brisk read rates, and even read an 8.5GB DVD+R DL we fed it
Price	$41
Features	
Internal/External	Internal
Interface	ATAPI/EIDE
Write/Rewrite/Read speeds (CD 1X= 0.15MBps; DVD 1X=1.35MBps)	52X/32X/52X CD-RW 16X DVD-ROM
Buffer Size	2MB
OS Support	Win98SE/Me/2000/XP
Disc Formats Supported	DVD±R/RW (read), DVD+R DL (read, as tested), Mt. Rainier, CD-Text, etc.
Testing	
Read Speed, Average	36.36X CD, 8.22X DVD
Random Access (in ms)	92ms CD, 100ms DVD
For More Information	www.liteonit.com
Overall Rating	

by Marty Sems

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Optimize Optical Drives

Firmware Updates & Other Tweaks

There's nothing quite like buying a 16X DVD writer only to find out that it doesn't write much faster than your 8X did. Or that your CD-RW doesn't seem to like any of the discs you're feeding it. Although there are lots of tweaks you can do to make sure your drive is playing well with Windows and apps, a situation such as either of these calls for a major optimization.

The most fundamental way to optimize your optical drive is to update its firmware. Firmware is the software that guides the drive to do what it's supposed to do. This can include not only how fast the drive can burn or read various DVD and CD formats but also how many specific types and brands of discs it can recognize, based on the dye in a disc's recording layer and other factors. Because most firmware is typically stored on rewriteable memory inside the drive, it's often updatable using a special utility from the drive's manufacturer.

Many vendors, such as Sony, Lite-On, and Plextor, are conscientious about re-leasing new firmware versions over time to correct various issues with their products. Early adopters often have to live with using certain disc brands or settling for lower write speeds until new firmware can fix their troubles. We'll tell you how we updated a couple of drives this way and also share a few tips and tweaks.

Firm Resolve

Most firmware upgrades add writing support for more brands of media. This can help your drive digest those corner store Memorex DVD-Rs you bought at midnight when your spindle of bang-for-the-buck Riteks ran out. Some new firmware versions also expand reading compatibility, such as to let a drive access one of the new 8.5GB DVD+R DL (double-layer) discs.

A handful of firmware updates correct bugs, but the most interesting upgrades are

Sony is famous for offering major speed boosts as free firmware downloads. Usually, though, firmware upgrades give a drive better compatibility with various discs.

the select few that raise the top burning speed of one or more types of discs. Sony is the most famous example of a DVD drive manufacturer that has offered such speed-boosting firmware. In a market in which the majority of vendors expected users to buy new drives to move from 2.4X DVD+R to 4X burning, for instance, Sony broke ranks to offer the new speed limit as a free download for its DRU-500 series of drives. The company did something similar with its DRU-530s, offering firmware to bump them up from 4X DVD-R to 8X and 2X DVD-RW to 4X.

Note that there have been reports of some firmware updates that actually diminish a drive's ability to make copies of protected software. For example, you might have had no problem backing up a particular game with your drive a few years ago, but now your backup CD-R has a corrupted stretch. You'd like to make another copy, but that last firmware update seems to have given your optical drive a fit of DRM self-righteousness. This can be a problem for those of us who subscribe to the Sony Betamax school of thought on the issue of fair use. Because most optical drive firmware isn't easy to roll back to a previous version, at least not without a third-party ute, check out the forums on sites such as www.cdfreaks.com and www.cdrlabs.com for advice and cautionary tales. There's much to sift through, but it can be useful.

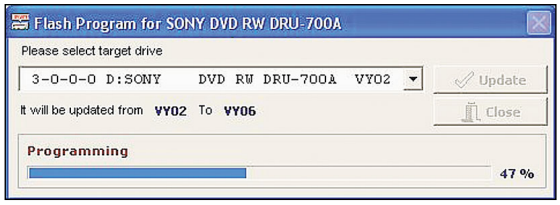
Firming Up

None of our Sony DVD drives were eligible for one of the company's firmware upgrades that add higher burning speeds. However, we did locate a DRU-700A with firmware version VY02. Here's how we updated it to the VY06E edition.

Always double-check the model number of your drive before you do any firmware upgrade. You don't want to flash the wrong firmware unless you really haven't formed any emotional attachment to your drive. Open the PC and look at the drive's label, or use a utility such as Nero's free InfoTool (www.cdspeed2000.com) to unearth the model number. InfoTool is also very handy for digging out your drive's current firmware version.

DVD burner. Make sure to download the proper update file for your specific drive. We found ours, 700a_vy06e.EXE, at sony.storagesupport.com/dvdrw/firmware.htm#700.

Sony advises logging onto your Windows XP PC using your administrator account, in case you've made more than one User Account. If there's a disc in your optical drive, eject it. Uninstall Intel's Application Accelerator (Intel Ultra ATA Storage Driver) if it's installed on your system. While you're at it, remove any



Our Sony DRU-700A's firmware update went smoothly. Whew.

Windows XP System Tweaks

You can sometimes fool consumer DVD players into playing more of your DVD+R/RWs by bitsetting, or setting the discs' booktype bit to DVD-ROM (www.dvdplusrw.org/Article.asp?mid=0&sid=2&aid=42). In our copy of Nero Burning ROM 6.3.1.25, we clicked Recorder, Choose Recorder, and Options to find this option, called Book Type Settings. Some software won't let you do this, so there are bitsetting utilities on the Web for various drives, such as DVDBitSetter (www.videohelp.com/tools?tool=503). As always, be wary of freeware/shareware not distributed by your drive's manufacturer, as well as hacked firmware.

The very deep Tweak-XP Pro 3.0.5 utility ($39.95; www.totalidea.com) lets you shut off WinXP's Roxio-based CD-writing feature, in case you use different burning software and would like to reclaim some RAM. It also lets you adjust Windows' cache size for your drive, specify a max read speed, and disable Autorun.

Meanwhile, CD/DVD Diagnostic 2.0.2 for Windows 9x/NT/Me/2000/XP ($49.99; www.infinadyne.com) claims to help your drive glean more data from scratched or corrupted discs. You can find a ton more CD and DVD utilities of all stripes at www.cdmediaworld.com/hardware/cdrom/cd_utils.shtml. ▲

packet-writing software and disable DMA for your optical drive, if you can.

Double-click the firmware update file to start the process. Read the warning message and then click Yes to continue. If you have more than one optical drive in your PC, be very careful to choose the correct one in the Please Select Target Drive field. When you're ready, click Update.

The next minute or two will be critical for your drive. If it's disturbed in any way, it could behave in unpredictable ways. It's likely not to work at all after something like this happens. You can try running the update utility again, but there are no guarantees that the burner will revive. If the update process seems to be taking a long time, it's better to give it the benefit of the doubt and let it run. After the flashing process, you'll need to restart your PC for the new firmware to settle. Click Now or Later to reboot on your own timetable.

We didn't expect our firmware update to propel our Sony into any higher speed categories, but we did hope for a little extra oomph. We ran some "before" and "after" benchmarks out of curiosity and logged them in this article's chart. All disc burn times started when we clicked the Burn button and ended when Nero 6.3.1.10 informed us that the disc was finished.

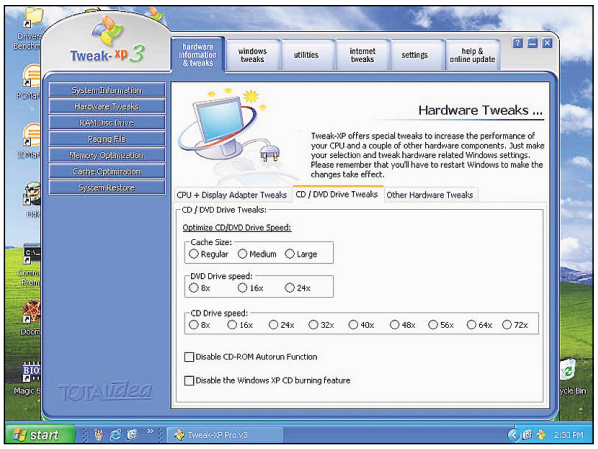
After the update, our Sony picked up a little DVD burning speed in most cases and didn't freeze during a DVD+R write as the drive did with the earlier firmware. It also gained a smidgen of DVD reading speed but lost a fraction of CD performance. Although the drive still doesn't fully-support our Verbatim 32X CD-RW discs, Sony says that our DRU-700A is now compatible with more media than ever.

CD-RW/DVD-ROM. We decided to update another optical drive while we were of a mind to. We were a-prepping our Lite-On SOHC-5232K for review in another section of this magazine, and we wanted it to have the latest firmware available. The SOHC-5232K is a combo drive, meaning that it's a CD-RW that can also read many DVDs. Technically, it's listed as a 52X/32X/52X/16X drive, meaning it's a 52X/32X/52X CD-RW and a 16X DVD-ROM.

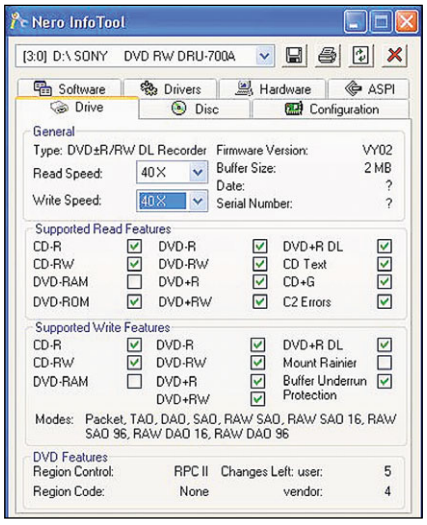
First, we located the drive's latest firmware version at www.liteonit.com/ODD/English/e_downloads/e_firmware_combo.asp. It turned out to be version NK0A, which seemed to be later (hexadecimally) than our drive's current NK07 firmware. The update's file name was Co52nk0a.ZIP. We saved it to our hard drive.

Next, we right-clicked the ZIP file and chose Extract All, Next twice, and Finish. You may need an unpacking utility if your compressed update file is of a different type, such as UnRAR for RAR files. If your file isn't compressed or is self-extracting, such as an EXE file, you're in the clear.

We double-clicked the resulting decompressed update file, now dubbed Nk0a.EXE. The flash utility reminded us that it was only intended specifically for the SOHC-5232K and warned us to remove any media from the drive and shut down other programs. We clicked Yes to continue and then Update. After half a minute or so, a message appeared that we had successfully updated the drive. Next, we followed the recommendation to reboot the PC. Nero's InfoTool confirmed that our optical drive was now clothed in the latest fashion.



Among TweakXP 3.0.5's arsenal of optimizations, there are several that apply to CD and DVD drives.



Nero's InfoTool can tell you your drive's firmware version. It's at the upper right.

Windows 98/Me System Tweaks

One of the quickest tweaks for better optical drive performance in Windows 98/Me is to enable DMA in the drive's Properties in the Device Manager, if it isn't already enabled. Before you do that with older equipment, however, make sure that both the motherboard and the drive support DMA. If you're in doubt, don't try it. We still have a five-year-old board that refuses to recognize an optical drive after we enable DMA, and there is no easy fix thus far.

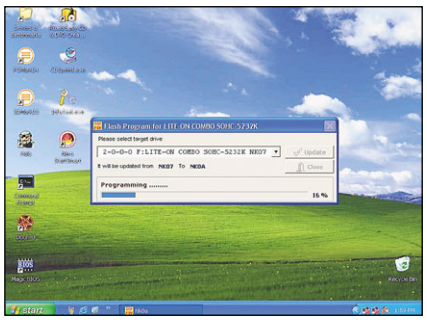
Plextor offers some Windows 98/Me/2000/XP tweaking software with its Premium CD-RW and recent DVD burners. VariRec, for example, lets you adjust the write laser's intensity to try and make burned discs work better in your player or older drive. Other utilities in the PlexTools Professional suite let you diagnose such esoteric phenomena as C1/C2/CU errors, laser focus mistakes, and jitter.

Lastly, there's WinBoost 4.88 ($29; www.magellass.com). Among other things, this intuitive tweaker's System & Booting menu lets you increase Win9x/Me's CD-ROM and DVD-ROM caches for smoother reads. ▲

Sony DRU-700A Firmware Update

We didn't expect a big speed boost from this broad firmware update, but we did shave some time off our DVD burns. Our Athlon 64 2800+ (754-pin) system had an EPOX EP-8HDA3+ motherboard, 512MB of PC4400 DDR at 400MHz, a Maxtor DM+9 80GB SATA hard drive, and Windows XP Pro SP2. Our burning software was Nero 6.3.1.10.

Firmware	VY02	VY06E
Write/Rewrite/Read Speeds (DVD 1X=1.35MBps; CD 1X=0.15MBps)	8X/4X/12X DVD+RW, 8X/4X/12X DVD-RW, 2.4X DVD+R DL, 40X/24X/40X CD-RW	8X/4X/12X DVD+RW, 8X/4X/12X DVD-RW, 2.4X DVD+R DL, 40X/24X/40X CD-RW
Disc Formats Supported	8.5GB DL DVD+R, DVD±R/RW, CD-R/RW, CD-Text, etc.	8.5GB DL DVD+R, DVD±R/RW, CD-R/RW, CD-Text, etc.
Read Speed, Average	29.5X CD, 6.36X DVD	29.21X CD, 6.72X DVD
Read Speed, Maximum	39.14X CD, 10.23X DVD	38.77X CD, 10.29X DVD
Random Access (in ms)	102ms CD, 119ms DVD	103ms CD, 120ms DVD
Full Stroke Access (in ms)	194ms CD, 212ms DVD	200ms CD, 203ms DVD
DVD±R Burn Test, 4GB (in minutes)	16:44 DVD-R Memorex 8X (DVD+R Memorex 8X froze halfway through)	15:54 DVD+R Memorex 8X, 16:28 DVD-R Memorex 8X
DVD±RW Burn Test, 4GB (in minutes)	20:52 DVD+RW Memorex 4X, 21:22 DVD-RW TDK 4X	20:47 DVD+RW Memorex 4X, 21:41 DVD-RW TDK 4X
CD-R Burn Test, 700MB (in minutes)	3:48 Ridata 48X at 40X	3:42 Ridata 48X at 40X
CD-RW Burn Test, 639MB (in minutes)	4:30 Samsung 24X (Verbatim 32X limited to 16X)	4:16 Samsung 24X (Verbatim 32X still limited to 16X)
Digital Audio Extraction Quality (of 10 points; clean 70-min. CD)	10 (accurate stream)	10 (accurate stream)



Here, we're giving our Lite-On combo drive some new firmware.

Deviation. On a side note, some intrepid users have reported success in flashing their drives with another brand's firmware. They use utilities such as MTKFlash and MTK Winflash (dhc014.rpc1.org/howto.htm#Download; the link is near the bottom) for drives containing MediaTek silicon, and LtnFW for Lite-On drives (club.cdfreaks.com/showthread.php?s=&threadid=83294). Others say they have revived drives with corrupted firmware using MKTFlash or other downloads. Still others have disabled their drive's DVD region code checking with "RPC1" firmware (tdb.rpc1.org).

These topics are really better suited for our *PC Modder* issue, so try this forum as a starting point: club.cdfreaks.com/forumdisplay.php?f=36. Be aware that using such third-party software increases the risk of turning your drive into a doorstop.

Don't Overlook The Basics

The most obvious way to keep your optical drive humming is to treat its media well. Keep discs in their cases or sleeves to keep them from getting scratched and dirty. Only wipe a disc with a soft cloth in a straight line from the center hole outward, never in a circular fashion.

Keep your ATAPI CD/DVD drive and your EIDE hard drive(s) on separate channels (each channel's cable can support up to two drives). This will keep your optical drive from possibly slowing down the hard drive's throughput, which can affect burning speeds through slower swap and temp file accesses. Verify that each drive's jumper is set appropriately for the cable connector it attaches to (master device on the end connector, slave in the middle), but avoid the C/S (cable select) setting if possible.

Other drive tweaks are actually just housekeeping recommendations. Download the latest updates for your burning software. Defragment the hard drive partition that your burner software uses for temporary storage, and make sure there's at least 5 to 9GB of free, contiguous space on that partition for DVD burning.

Obviously, your system needs to have enough RAM, too. 256MB is probably the minimum for DVD writing in WinXP, unless you have lots of time to kill. Even with 512MB of RAM, our Athlon 64 2800+ PC spent at least 10 minutes spooling our 4GB project before Nero ever gave us a Burn button to click.

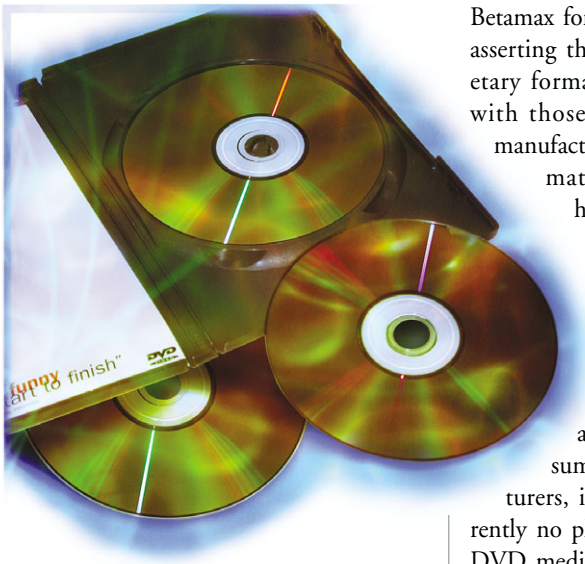
Finally, try different brands of discs to see what works best in your drive. That's almost insultingly obvious, but it's surprising how many problems you can solve with different media. CPU

by Marty Sems

Tech White Paper:

DVD STANDARDS

Unraveling The Differences



In July 2004 the German daily *Bild* quoted Microsoft chairman Bill Gates as saying that DVD technology would be "obsolete in 10 years at the latest" because DVDs can easily become scratched or lost. But if DVD technology dies out that soon it won't be for manufacturers' lack of trying.

Drive manufacturers and software developers have made DVD burning easier and cheaper for the masses. And media-makers have taken a playing field once filled with a dizzying array of DVD formats and whittled it down to a select few. There is, however, still enough variety to cause confusion, and two new formats are gaining big steam. So in this white paper we'll identify the formats and trends and help you distinguish between them.

Backgrounder

The video cassette market began with a technology battle between the VHS and Betamax formats, with competing groups asserting the superiority of their proprietary formats. The licensing associated with those formats meant equipment manufacturers had to decide which format to support and build their hardware to fit the physical attributes of the cartridge.

The same kind of battle raged in the DVD market in terms of technological claims and counterclaims. However, the consequences are much better for both consumers and DVD drive manufacturers, in part because there are currently no physical size differences among DVD media as there were between VHS and Betamax tapes.

The DVD media landscape started out with a split personality, with Philips' and Sony's proprietary MMCD (MultiMedia Compact Disc) competing in 1995 against Time-Warner's and Toshiba's proprietary SD (Super Disc) format. Approved in 1996, the first true DVD specifications—DVD-ROM 1.0 and DVD-Video 1.0—drew from the SD model, with a 120mm diameter and 1.2mm substrate that matched the physical dimensions already established for the compact disc.

With this complementary pair of specs as a starting place, all DVD drive manufacturers could conceivably produce drives capable of writing and reading the same discs, but technology developers and patent owners still wanted to be able to charge a license fee for each drive sold. This encouraged (and continues to encourage) technology owners to add advanced features to their individual formats.

Since DVDs entered the mainstream in 1995, numerous formats have come and gone, but two have dominated. On one side there's the so-called dash-R format group, which loathes use of the word "minus" to distinguish its DVD-R, DVD-RW, and DVD-RAM formats from the competition. This group, founded by Hitachi, Matsushita, Mitsubishi, Pioneer, Philips, Sony, Toshiba, and others, calls itself the DVD Forum (www.dvdforum.org).

On the other side there's the DVD+RW Alliance (www.dvdrw.com), which supports—you guessed it—the DVD+R and DVD+RW formats and consists of members such as Dell, HP, Ricoh, Thomsen, and Yamaha, not to mention apparent hedge-betters Philips and Sony. The DVD+RW group used the plus sign purely for marketing purposes, wanting the "-" in DVD-R/RW to be seen as a "minus," implying it's less than the "plus" disc format.

For consumers, format differences were a pain at first, with DVD-R/RW drives unable to accommodate DVD+R/RW media and vice versa. But this has become less of a problem as drive manufacturers strive to make drives that support multiple, previously incompatible formats. Today, consumers can play (and often burn) DVDs using a variety of media formats in a single drive. This means that a consumer can buy whatever media happens to be available or priced lowest and use it in the drive they own. And yet, competition thrives and researchers continue to develop new methods for increasing DVD capacities; we'll discuss new technologies momentarily, but for now let's take a look at some basic DVD differences.

Specs & Formats

As we mentioned, the physical size of all retail DVDs (and CDs for that matter) is 120mm in diameter and 1.2mm thick. However, raw DVDs are only half the thickness of raw CDs. The slimmer form factor is part of the design that contributes to the improved storage capacity of DVDs over CDs.

In the beginning, engineering DVDs to be as rigid and durable as CDs required beefing up the design. To solve this dilemma, complete DVDs are actually two DVDs layered back to back. This provides the necessary stability to the disc and allows for the possibility of double-sided recording. Retail discs, though, may only have a single side available for recording, with the flipside free for a label.

The disc formats are different, and even though it is possible to use almost any disc manufacturer's DVD media in most any drive, the differences show up in the names of the formats and in the underlying technology built into the different formats.

If you are buying a prerecorded DVD, you don't have an option of selecting which format you want. You simply buy the product and put it into your DVD player or computer. However, there are five basic versions of recordable DVDs to choose from: DVD-RAM, DVD-R, DVD-RW, DVD+R, and DVD+RW.

Formats Galore

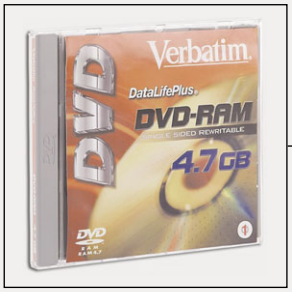
The terminology of DVD designations can be confusing to say the least. DVD evolution has had some influence on the format names, and the first few names were relatively descriptive. Here's a list of the top formats on the market today. ▲

OVER 80 FOUR STAR RAVE REVIEWS!
"GETTING LOST NEVER FELT SO GOOD!"
BILL MURRAY
SCARLETT JOHANSSON
LOST in TRANSLATION
Written and directed by Sofia Coppola

DVD-Video. Designed specifically as a storage medium for feature-length movies, DVD-Video is meant to store a combination of high-quality video and audio.

DVD-Audio. With support for up to six channels, higher frequency response, and broader dynamic range, DVD-Audio is a digital audiophile's choice over the CD. Relatively few albums are available in this format, though.

DVD-R/RW. DVD-R is similar to DVD-ROM in that it allows a write-once, read-many format much like the familiar CD-R. DVD-RW is a rewriteable version of DVD-R.



DVD-RAM. Although part of the DVD-R/RW family, DVD-RAM uses a cartridge enclosure. Typical DVD-RAM drives accommodate other DVD formats, but to use a DVD-RAM you must have a DVD-RAM drive. DVD-RAM uses random-access memory so you can add and delete data much the same way you would using a hard drive.

DVD+R/RW. DVD+R/RW are competing versions of the writeable DVD-R and DVD-RW formats.

DVD±RW. DVD±RW isn't a unique format, but we include it here because the designation is becoming more common for DVD drives. It means that the drive supports both DVD-R/RW and DVD+R/RW media.

DVD-Multi. Also not an actual format, DVD-Multi is an umbrella term for DVD-R/RW, DVD-RAM, and compatible formats.

DVD-RAM was the first rewriteable DVD format available. The format includes the ability to manage defects in the data recorded on the disc. Defect management makes use of DVD-RAM well-suited for use in computers, but the format is not compatible with most DVD players because of technical differences in this format and the later formats. DVD-RAM discs also rely on a cartridge to house the disc.

The DVD-R/RW (aka DVD-R/W) and DVD+R/RW formats are most readily available on store shelves today. They have much in common, and in fact, the technical differences between them can be ignored by most users because drive manufacturers have accommodated the differences in their designs.

The proponents of the DVD-RW format claim the format is more compatible with older players. So, if you know you will be distributing a disc for use in a player more than two years old, you may want to stick with the DVD-RW discs. Check out the "Formats Galore" sidebar for details about DVD formats.

Speed

Looking solely at the numbers associated with CD and DVD speeds, it would seem that CD drives have reached amazing reading speeds in the range of 64X, while DVDs are lumbering along in the range of 8X. In fact, the difference is in the measurement, not in the throughput.

DVDs pack data much more densely on each track. Because more information passes the reading head during each revolution of the disc, more data is picked up in each pass. That means the DVD format allows for significantly higher data transfer rates at slower spin rates.

A CD spinning at 1X is transferring 150KB of data per second, while a DVD spinning at its 1X rate is moving 1,250KB of data per second. Therefore, the 64X measurement attributed to a CD drive's data transfer speed is roughly the equivalent of an 8X measurement attributed to a DVD drive's data transfer speed.

Capacity

There are a couple of things to consider when it comes to deciphering DVD capacities. First, there's a difference between single-layer DVDs, which have a stated capacity of 4.7GB per side (more about our use of the word "stated" in a moment) and dual-layer DVDs, which have two recordable layers on one side and can hold nearly twice the amount of data as single-layer discs. Using two layers is accomplished by refocusing the writing or reading laser on one or the other layer. Two-sided DVDs are also available, which obviously doubles the capacity of comparable single-sided media.

Just as there are differences in the technical specifications of the single-layer formats, there are different ways to deal with recording to and reading from the dual-layer discs. But even with this increased capacity, the dual-layer discs are compatible with most existing DVD players. Dual-layer disc drives are relatively slow when it comes to burning discs and can only write at around 2.4X compared with standard single-layer drives that burn DVDs in the 12X range or better. Dual-layer DVDs are relatively expensive, too, with a premium cost in the range of $8 to $10 per disc vs. $3 or less for a standard DVD.

The second fundamental consideration when looking at DVD capacities is the difference between a DVD's capacity as stated on the label and a DVD's actual capacity when you slip it into your drive. You'll notice, for example, that a so-called 4.7GB DVD+R really only holds 4.38GB worth of data. That's because DVD manufacturers use binary multiples to express the number of bytes (that is, 1KB equals 1,000 bytes) as opposed to the computer industry standard. (That is, 1KB equals 1,024 bytes.)

DVD terms relating to capacity include DVD-5 (a single-sided, single-layer 4.7GB DVD that truly holds 4.38GB), as well as the less familiar DVD-9 (a single-sided, dual-layer 8.5GB DVD that truly holds 7.95GB), DVD-10 (a two-sided version of DVD-5), and DVD-18 (a two-sided version of DVD-9).

Blu-ray & HD-DVD

High Definition TV has brought about the need for DVD discs with increased storage capacity because the two-hour movie that fits easily on a standard 4.7GB DVD requires as many as five DVDs when recorded in HD. The two hot trends in DVD development poised to compete for delivering more capacity: Blu-ray and HD-DVD.

Blu-ray technology uses a blue laser that makes smaller marks on the disc and thus can put more marks in the same space, delivering up to 27GB of storage on a single side of a disc. That's enough to hold a full two hour high-definition movie on a single disc. The competing HD-DVD technology can deliver up to 15GB per side. The promoters of this format expect to use more efficient compression techniques to squeeze an HD movie into the 15GB format.

The HD-DVD format uses the same laser equipment used in current DVD drives and is said to be compatible with the technology used by both the manufacturing equipment and players. Because of this, manufacturing HD-DVD discs will be less expensive than Blu-ray discs because the HD-DVD process won't require drive manufacturers to build entirely new systems. Blu-ray discs would not be compatible with existing laser technology. This is expected to increase the cost to manufacture the Blu-ray drives.

Expect to see these higher-capacity systems on the market at premium prices sometime in 2005.

More, Bigger

As with all things storage, expect capacities to increase. Sony has recently announced its intention to produce Blu-ray DVDs with four layers rather than one. These discs will deliver 100GB of storage and should be commercially available by 2007. At the same time, Sony said it is working on a version of the disc with eight layers and expect the capacity of these discs will be in the range of 200GB but didn't give an expected availability date.

What will Sony put on those discs? Maybe it wants to archive all the movies recently acquired in its purchase of Metro-Goldwyn-Mayer. CPU

by Scott Koegler

PSU Roundup

Test platform:

Intel D925XECV2, Pentium 4 3.46 GHz EE (1066 FSB), NVIDIA 6800 GT, 1GB Kingston HyperX DDR2, 250GB Hitachi Deskstar, 200GB Maxtor DiamondMax Plus 9, 40X Mitsumi CD-RW, 16X MSI DVD-ROM, Cooler Master Musketeer LLC-U03, 2 x Ultra 80mm case fan, 2 x Ultra UV cold cathode lights. Measurements were taken with a Tektronix DMM850 voltmeter.

Test process:

Measurements taken on last Molex connector of a power connector string. Load created by simultaneously running a demo in DOOM 3, Sandra 2004 CPU burn-in at 50%, DVD Decrypter from MSI DVD to Maxtor HDD, and copying files from CD to Hitachi HDD.

Aerocool AeroPower Black/Silver Line 550W

Aerocool AeroPower Black/Silver Line 550W							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
550W	625W (30 sec)	36A	36A	30A	Idle	5.114 - 5.116	12.019 - 12.020
					Loaded	5.115 - 5.118	11.943 - 11.986

The rear- and bottom-mounted fans feature 11 silver-coated blades, and we observed that when spinning, the blades exhibit some kind of optical illusion that's hard to describe but appears like liquid flowing. All of the wires are encased in white wire mesh wrap to help keep things tidy inside the case.

Aerocool shares its generous wattage among a wealth of connectors: eight 4-wire Molex, two 4-wire floppy, two SATA, and one 6-wire auxiliary owing to this being an ATX12V v1.3-compliant power supply. The Molex connectors are easy-remove, meaning that each features a spring curve of plastic on the top and bottom of the connector. Additionally, because the PSU uses a 20-wire ATX power connector (and includes a 4-wire ATX12V connection, as well), our Intel board knew to request an additional 1x4 Molex connector be plugged into the motherboard's auxiliary plug. We did this, but the easy-remove spring made for uncomfortably cramped quarters among the board's capacitors.

Aerocool claims that the B/SL family is "extremely silent." The point is that when we put our ear up close to the fan we couldn't hear any noise.

With a 625W peak capacity, this AeroPower model compares quite well against ATX12V v2.0 competitors, looks sexy, and exhibits only a slight and inconsequential amount of wobble on the 12V rail under load. Street prices are now under $80, making this a great value for towers still using AGP graphics and predominantly parallel ATA drives. ▲

Aerocool AeroPower Black/Silver Line 550W
$85.99
www.aerocool.us
CPU CPU CPU CPU

by William Van Winkle

Antec NeoPower 480

Antec NeoPower 480								
Cont. Watts	Rated Peak	+3.3V	+5V	+12V1	+12V2		+5V	+12V
480W	N/A	30A	38A	18A	15A	Idle	5.069 - 5.071	11.957 - 11.959
						Loaded	5.041 - 5.043	11.932 - 11.936

The rear of the NeoPower is a wall-to-wall grille for maximum airflow. The only fan is a 120mm bottom-mounted unit that stays essentially silent under light to moderate loads, although we did hear a slight buzz from the electronics when we got up close to the fan. The 24-wire ATX power cable is sleeved in black mesh, and the 4-wire ATX12V line is zip tied for tidiness. These, along with the 2x12V fan speed monitor, are the only hard-mounted wires.

The front of the PSU features four 6-wire sockets and one 2-wire socket. This latter socket is for a special cable that features two 2-wire, Molex-style, fan-only connectors. The 6-wire sockets connect to various cables that you can plug in as needed. One of these cables offers two SATA connectors. Another is for the 6-wire PCIe plug. Three of the cables deliver three 4-wire Molex plugs each, and there's a splitter that converts one 4-wire Molex into two 4-wire floppy connectors. Antec even throws in a 24- to 20-wire ATX converter, as well as two 4-wire Molex and two SATA connectors that you can *crimp onto* the existing cables. Cool!

In addition to being ATX12V 2.0, this is also Antec's first consumer power supply with APFC (active power factor conversion), which helps with energy efficiency.

Although some will consider the NeoPower's matte bronze/gray finish boring, we found it tastefully muted and definitely not cheap-looking. ▲

Antec NeoPower 480
$149
www.antec.com
CPU CPU CPU CPU CPU

by William Van Winkle

CPU Ranking: 0 = Absolutely Worthless CPU CPU 2.5 = Absolutely Average CPU CPU CPU CPU CPU 5 = Absolutely Perfect

Antec Phantom 350

Antec Phantom 350								
Cont. Watts	Rated Peak	+3.3V	+5V	+12V	+12V2		+5V	+12V
334W	350W	28A	30A	16A	18A	Idle	5.002 - 5.004	11.962 - 11.963
						Loaded	4.995 - 4.997	11.934 - 11.952

Given the extreme variance of designs and the need for a unit to compare against our SilverStone, we allowed Antec an extra review here. The all-black Phantom 350 is a fanless power supply with extruded aluminum heatsinks bolted to the unit's top and bottom that bond to several of the hot internal components. Being fanless, this unit is completely silent, even under heavy loads. We were unable even to hear any electronics buzz with the CPU and GPU fans temporarily silenced.

Intel's minimum recommended spec for ATX12V v2.0 systems is 350W, and this PSU had no problem handling our task-intensive load. Antec boasts better than 85% circuitry efficiency, meaning how efficiently input power is used within the device. Lower efficiency will result in greater heat output, and without a cooling fan, low efficiency would spell doom for this design. The good news is that Antec delivers as promised. After 30 minutes of run-time, we tucked a temperature probe inside the top heatsink fins and got a readout of 35 degrees Celsius. That's pretty warm to the touch, but nothing you couldn't leave your hand on. After one hour, we were up to about 53 C. If you plant a 53-degree heater in your chassis, you'd better have some decent case fans in place to handle airflow. We wouldn't even trust water cooling to protect components from that sort of slow roasting. This isn't to say that the fanless design is futile for ensuring silence. You just need to pay attention to getting very quiet air cooling elsewhere in the box. Perhaps 120mm fans and a little modding are in order.

Being v2.0-compatible, Antec provides 24-wire ATX power (with a 20-wire adapter), 6-wire PCIe, and two SATA connectors on top of the 4-wire ATX12V, seven 4-wire Molex, and two 4-wire floppy connects. We like the blue LED bar across the top of the rear face, too, as it's a sexier way of showing that, yes, this thing really is on.

All in all, the Phantom is an impressive achievement sure to reward those who exercise some thermal forethought.With the fanless Phantom 350, Antec delivers a hot design for those willing to pay a premium for silence. ▲

Antec Phantom 350
$199
www.antec.com

by William Van Winkle

Aspire Concord ATX-MR500W

Aspire Concord ATX-MR500W							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
N/A	500W	28A	30A	34A	Idle	4.922 - 4.927	11.294 - 11.300
					Loaded	4.866 - 4.888	10.699 - 11.037

With a street price hovering around $55, Aspire's 500W Concord is a cautionary tale for those who are looking to get a PSU that looks like an expensive unit but isn't. Even before we plugged in the Concord, there were three red flags with this unit: 1) It felt too light. Solid electronics weigh solidly in your hand. 2) The documentation is poorly translated, and Aspire's Web site looks like it was produced by the company's shipping manager. We're not trying to be English lit snobs about this, but product quality and translation quality have a funny tendency of being related. 3) The PSU comes with an 80mm clear plastic case fan and a Molex power splitter connected to a fan control dial that fits into a backplane slot. The dial can control up to five case fans.

The case fan thing sounds like a good idea, but we really think ThermalTake did this idea better. Most people don't bother with rear-mounted controls, and Aspire's implementation doesn't provide enough information to be anything more than a noise adjustment. There is also a speed control knob for the two integrated 80mm fans (rear and bottom), but this feature has become superfluous in light of smart controls based on the motherboard.

All of this so far is forgivable. The real sin here is the shoddy electronics quality. Intel's power supply specs say that voltage variance of up to ±5% on a rail is acceptable. Thus, on the +12V rail, readings from 11.4 to 12.6V are fine. We were stunned to see the Concord drop below this during idle and then plummet more than 10% under load. There's no way we would trust our PC components to such wild variance.

The best thing about the Corcord, aside from its deservedly low price, is the black mesh sleeving on all of the wires. For connectors, Aspire provides a 20-wire ATX, 4-wire ATX12V, two SATA, eight 4-wire Molex, and two 4-wire floppy.

Looks can be deceiving. The Aspire Concord ATX-MR500W, with its promising cosmetics and throw-away electronics, proves that looks can be deceiving. ▲

Aspire Concord ATX-MR500W
$79
www.aspireusa.net

by William Van Winkle

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Cooler Master Real Power 450W

Cooler Master Real Power 450W								
Cont. Watts	Rated Peak	+3.3V	+5V	+12V1	+12V2		+5V	+12V
470W	530W	30A	35A	18A	16A	Idle	5.077 - 5.079	12.148 - 12.160
						Loaded	5.102 - 5.144	12.029 - 12.062

When Cooler Master rates this PSU as 450W, that's 450W of continuous power. Most vendors quote peak power numbers, which are meant to handle only fleeting spikes. In reality, most PSUs are meant to be operated at or below 75% of their rated capacities. Only the good ones can operate at 100% constantly.

That said, the ridiculously named "human interface device" that comes bundled with the unit and fits into a 3.5-inch bay uses a needle meter to display approximate wattage consumption from 0 to 600W. Even at full load, we were hard pressed to squeeze over 300W. (Maybe keep that in mind before shelling out for a 600W model.) Once your wattage is determined, though, the blue-lit accessory ceases to be of much practical use, but it stays pretty.

Save for the omission of a six-wire PCI-E connector, the Real Power 450W is ATX12V v2.0 compliant and includes a 20-wire ATX adapter. You get two SATA, seven four-wire Mo-lex, and two six-wire floppy connectors, all on generously long, 80cm cables. Only the ATX power cable is wrapped in black mesh, though, and the Molex connectors use the same easy release design found with the AeroPower, only Cooler Master colored its connectors blue. This is doubtless supposed to coordinate well with the blue LEDs illuminating the PSU's bottom-mounted 120mm fan, but the connectors just look . . . odd.

Great on power with just enough bling to keep you looking, the Cooler Master Real Power 450W is a great entrant in the sub-$100 category. Good value.

The fan defaults to spinning at 1,200rpm and doesn't jump to 2,400rpm until after hitting a 50% load. Even at idle, we could hear a faint hum from the unit, but the point is moot when even moderately noisy PSUs are now drowned out by the CPU and GPU fans.

With only a slight voltage wobble, the Real Power performs solidly and poses no worries. Cooler Master's matte black finish and honeycombed rear grille are attractive, especially in a black chassis. We wish all of the wires were sleeved, but it's hard to argue with these solid numbers for under $100. ▲

Cooler Master Real Power 450W
$99
www.coolermaster.com

by William Van Winkle

Fortron Source AX500-A

FSP Group AX500-A								
Cont. Watts	Rated Peak	+3.3V	+5V	+12V1	+12V2		+5V	+12V
460W	500W	30A	28A	17.5A	17.5A	Idle	5.049 - 5.050	12.012 - 12.014
						Loaded	5.052 - 5.057	11.850 - 11.934

Call us crazy, but there's something exciting about taking the wrap off of a new component and smelling paint, and the paint is the first thing you notice on the AX500-A—purple paint, mesh wrap, and power connectors with a blue 120mm fan and blue rubber securing each end of the mesh wraps. Some purists may not dig purple and blue; we think that in the right case, it'll look pretty swank. The mesh sleeves glow well under UV lights, too. Interestingly, there are no LEDs illuminating the fan, but there is a little light behind the power rocker switch.

FSP sent us the AX500-A with little background to go on. The Blue Storm series isn't even posted on the company's site as of this writing. Still, Fortron tells us that the PSU achieves better than 80% efficiency, and the unit is fully ATX12V v2.0 compliant, so you get the six-wire PCI-E connector on its own dedicated line. Also included are two SATA, one four-wire floppy, and eight four-wire Molex connectors with easy release springs. Only the 24- to 20-pin adapter is not mesh wrapped.

Typical of quiet Fortron models, the AX500-A offered no discernable fan noise and only a light buzz from the electronics.

Feeling blue? The solid performance and value in FSP's new AX500-A will have you feeling cheery in no time.

FSP doesn't try to hide that its continuous power is actually rated at 460W, although Fortron is notorious for underrating its PSUs. The AX500-A is slightly behind its competitors for capacity on the +5V rail, which is something you may want to watch if you plan to load your machine heavily with drives and USB/FireWire peripherals. Still, our unit gave us no trouble at all. We saw the usual amount of +12V fluctuating under load, and everything stayed nicely within spec.

The Fortron AX500-A's distinctive color scheme won't be for everyone, but the price and performance should make amends. ▲

Fortron Source AX500-A
$99.99
www.fspgroup.com

by William Van Winkle

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

SilverStone SST-ST30NF

SilverStone SST-ST30NF							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
250W	400W+	20A	21A	17A	Idle	5.094 - 5.096	11.997 - 12.001
					Loaded	5.093 - 5.098	11.894 - 11.929

Be careful which numbers you look at for this fanless PSU. We've quoted the ratings here based on 100 to 120V input. The 300W and higher rail numbers you see are based on 200 to 240V input. The ST30NF does the switching internally, so you don't have to worry about it.

In fact, all things considered, this unit's performance is downright amazing. Because its efficiency varies generally from 70% to 80%, this model runs hotter than the fanless Antec. We left Sandra 2004 on a 50% CPU burn-in with 3DMark05 looping continuously at 1,280 x 1,024 for 90 minutes and came back to find the PSU's temperature alert LED glowing red. (It changes from green to red at 55 C.) Our temperature probe reported a fiery 75 C on the extruded aluminum exterior—too hot to touch for more than an instant. Yet incredibly, our tests were still running and with very stable voltages. The unit smelled hot, but not melting hot.

Like Antec, SilverStone's voltage regulation is quite good. The rail ratings look alarmingly low, but, again, we experienced no problem with this. The only real concern here is ventilation. If you have to compensate for all this heat with more fans, have you just negated the noise benefits of a silent PSU?

SilverStone wraps the 20-pin ATX power, four-wire ATX12V, and six-wire auxiliary lines in black mesh. The two SATA, two four-wire floppy, and six four-wire Molex connectors all have unsheathed lines and no other fancy features. SilverStone presents a $50 savings over Antec, but Antec runs cooler, looks better, and presents more connectors. Both offer three-year warranties. Tough call, but we'll give Antec the nod owing to its lower temperatures. ▲

Cool and cookin' at the same time, SilverStone's fanless SST-ST30NF dishes up silence you can practically fry an egg on.

SilverStone SST-ST30NF
$149
www.silverstonetek.com

by William Van Winkle

ThermalTake PurePower TWV480

ThermalTake Silent PurePower TWV480							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
480W	550W	30A	40A	18A	Idle	5.175 - 5.177	12.008 - 12.015
					Loaded	5.194 - 5.209	11.744 - 11.820

We were pleasantly surprised by the TWV480. The ThermalTake delivers good performance and a fair dose of bling. The twin 80mm orange fans in the rear and bottom of the PSU give the impression of copper behind their gold grilles without there actually being any copper. ThermalTake rates the noise output of the unit at 17dBA at the lowest spin rate of 1,300rpm. You want to make sure and use the bundled bay device or smart mobo ports to control this, though, because the uncontrolled 3,000rpm rate is really loud.

The TWV (Total Watts Viewer) 5.25-inch bay device offers two knobs for fan control and a central readout of your PC's watt consumption. The look and feel of the bezel and knobs is a bit cheap, but not tacky. Our point of concern, though, is that our peak loads only registered in the 170s. Keeping in mind that Cooler Master's display had us nudging over 300W, we suspect ThermalTake's numbers may be a bit conservative.

ThermalTake decided to have some fun with the mesh sleeves. The 20-pin ATX line is sheathed in black. (There is also an unsheathed 24-wire adapter.) The ATX12V line is in red, while the line featuring two SATA connectors is green. The remaining three lines done up in blue sport nine four-wire Molex connectors with easy release springs and two four-wire floppy connectors. For-tunately, the 40A +5V rail leaves plenty of headroom for drives, but 18A for a lone +12V rail strikes us as a bit underpow-ered for a modern PSU with a 480W continuous rating. Particularly if you're into overclocking with cutting edge CPUs and GPUs, keep a close eye on this. We're also slightly concerned about edging up toward that 5% spec ceiling while under load on the +5V rail.

If you're not too literal about your wattage readouts, this unit offers stable performance with only a couple of caution points for future upgrading. ▲

ThermalTake delivers a rainbow of mesh sleeves in this high-wattage value PSU that runs well but may have some issues down the road.

ThermalTake Silent PurePower TWV480
$74.95
www.thermaltake.com

by William Van Winkle

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Ultra X-Connect 500W ATX

Ultra X-Connect 500W ATX							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
500W	500W	28A	30A	34A	Idle	5.157 - 5.158	12.259 - 12.263
					Loaded	5.161 - 5.171	12.001 - 12.049

When we received the titanium version of this PSU, we thought we'd suddenly slipped into power supply nirvana. The modular Antec hadn't hit our office yet, so this was our first look at a fully detachable design. Nothing is hardwired here. So between the mirror finish, acrylic side panels, radiant blue LED-lit interior, Ultra-branded grilles, and UV-reactive silver braided cables, we were awestruck.

But sort of like when your first date with a hottie is tarnished when he or she whips out a chronically annoying laugh, we grew suspicious when three of the rubber plugs covering the cable ports fell off. Hmm. Upon closer inspection, we found that the unit was actually short on connectors. Even with the bundled one-Molex-to-two SATA splitter, we had no leftover power plugs (remember, you lose three Molex plugs feeding the auxiliary mobo connector and high-end PCIe graphics card). Well, there were two six-wire auxiliary cables still in the box, but come on—why not swap those for something more useful?

But we definitely can't complain about the performance. Between the super-quiet twin 80mm fans, we only heard a faint whir and electronic buzz that was buried by our 6800 GT. Add to this the aggressive rail voltages, and Ultra tack-led all our needs. A product line update to ATX12V v2.0 should cure most of our complaints. And given that street prices slip under $100, this is a top contender for any clear case enthusiast. ▲

With a radical new cable design and stunning looks, Ultra's X-Connect 500W is one catch you won't let slip away.

Ultra X-Connect 500W ATX
$149.95
www.ultraproducts.com

by William Van Winkle

Vantec ION 2 350W

Vantec ION 2 350W							
Cont. Watts	Rated Peak	+3.3V	+5V	+12V		+5V	+12V
350W	400W	14A	30A	15A	Idle	5.220 - 5.221	12.031 - 12.034
					Loaded	5.536 - 5.558	11.726 - 11.801

With the ION 2, Vantec aims for a respectable, budget-oriented power supply. The unit is painted in all black, with honeycomb venting for the rear wall and a silver grille-covered 120mm fan down below. As with many 120mm designs, we found the Vantec to be silent during idle and only barely audible under load.

Because this model addresses a budget audience, Vantec didn't worry about meeting ATX12V v2.0 spec. In addition to the 20-wire ATX line (there is no 24-wire adapter) and ATX12V line, Vantec provides two SATA, one six-wire auxiliary, two four-wire floppy, and six four-wire easy release Molex connectors. The connectors and mesh sheathing are all in black, so the effect is simple but attractive. Our only problem was that the ATX12V line is so short that we had to snip Vantec's zip tie around all of the wires.

Although the ION 2 didn't collapse on us under load, we felt that it was getting pushed pretty hard. Our load numbers on the +5V rail are way above tolerable levels, and even the idle ratings on +5V are at the top end of what spec will allow. A light amperage limit on +3.3V is fine because most devices don't access this channel, but only 15A on the +12V line is dangerously low for anyone looking to upgrade later on.

We can't argue too loudly with a $60 MSRP. Midrange buyers with sub-3GHz configurations and a handful of drives should do well here. ▲

Vantec's ION 2 350W is short on eye candy and isn't built for heavy lifting, but it should serve budget buyers well.

Vantec ION 2 350W
$59.95
www.vantecusa.com

by William Van Winkle

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

The Big Overload

Find Out Just How Far You Can Push A Power Supply

Our 250W PSU powered all of these devices, and more, without conking out. However, programs ran slower than usual and we experienced other glitches, as well.

Power supplies are the Rodney Dangerfields of PC components—sometimes, they just don't get any respect. But without reliable zaps from a PSU, your computer will come to a screeching halt, sort of like a certain comedian's career when he no longer delivers juiced-up jokes with spark.

To avoid having a PC that's washed up, you'll have to give PSUs their due. Here, we'll explain exactly why PSUs are so important, tell how they deliver power to different components, and offer tips for preventing power-related PC problems now and in the future.

Power Supply Basics

If you're not already familiar with the fundamental tasks that a PSU executes during startup and idle periods of a computer session, it's time you learned. Understanding these basics won't make you an electrical engineer, but it'll help you make better decisions regarding your computer's vital components.

Your PSU starts its job by pulling in electrical power from a wall outlet. This power comes in AC form, so it must be converted into the DC voltages that are used by computer electronics; the three most common voltages used by these parts are 3.3, 5, and 12 volts. The 12V power typically goes to electricity-hungry motors in optical and hard drives, while the lower voltages are used for digital circuitry. Some PSUs also provide voltages of -12, -5, and others, but as technology has changed, so have power requirements. For the specific voltages (also called rails or lines) your PC needs, the PSU provides each voltage at specific levels to meet the demands of all your system's parts.

Of course, not all systems are the same. Older PCs with just a drive or two, 128MB of RAM, and a slow processor have only a fraction of the power requirements of a contemporary high-end gaming system. As a result, PSUs are always getting more powerful, as you can tell by glancing at a spec sheet. Whereas PCs from a few years ago often shipped with 250-watt PSUs, newer machines often include 350- or 400-watt PSUs.

But what exactly does that wattage rating mean? Watts are the product of voltage and current, for which we use the terms volts and amps, respectively. We'll explain why these terms are important later in this article.

Form factor. Form factor is an important consideration when choosing a PSU. Most desktop motherboards and cases adhere to the ATX form factor that was introduced in 1995. Selecting a PSU with the ATX form factor ensures that the PSU will fit neatly into the PC case and also that its power connectors will work with an ATX motherboard.

Server-level CPUs, dual-processor PCs, mini-ITX systems, and other specialty machines often require PSUs with different form factors and voltage capabilities. For the purposes of this article, we'll stick with the ATX form factor used by the vast majority of PC enthusiasts. An ATX form factor PSU measures 86mm high x 150mm wide x 140mm long and typically has an 80mm fan to help exhaust hot air generated by the device's internal components. And unlike other form factors that force the motherboard's voltage regulators to supply +3.3V power, ATX PSUs can provide this voltage directly.

Manufacturers typically tout the number of watts a PSU can handle as a marketing tool. The wattage capability gives you, at a glance, an idea of how much of a power load you can expect the device to provide. From major retailers, you can find PSUs with ratings of around 150 watts all the way up to around 600 watts. Prices for these products range from $10 into the hundreds of dollars.

Of course, just because you buy a 400-watt PSU, you won't necessarily always be drawing that much power. Your PSU is designed to siphon only the power it needs from your home's electrical system. You can check the label on the side of any PSU to find its wattage rating and also to see each voltage and current rating.

Picking a PSU. But how do you determine what PSU to buy for your system? Do you need an inexpensive 250-watt PSU, or should you spring for a 500-watt behemoth that costs much more? You'll want to take a number of factors into consideration before you make your final choice.

For starters, keep in mind that PSU ratings are often very misleading. Just because a manufacturer claims a PSU will support 500 watts doesn't necessarily make it so—in some cases, that PSU might provide only 480 watts of consistent power. Brand-name PSUs are often a better bet for accurate power ratings, but there's no way to determine which PSU might short-change you, so be sure you get a PSU with enough muscle (it pays to spend a little more now). Don't wait until your system develops problems resulting from power shortages, as this often happens when users upgrade their PCs with new PCI cards or other components.

It's also important to remember that each power rail created by the PSU is used for different devices in your PC. This factor is especially important when you consider that some PC parts, such as optical drives, often require twice as much current to start up their motors as they do when they are idling, meaning that having more than one drive can create great stress on your PSU for short periods of time, and for a specific voltage (that on some PSUs will be in short supply). Some manufacturers anticipate these kinds of problems and create PSUs that can withstand normal output capabilities for short durations. This is called the peak power rating, and it's often listed only for the 12V rating where this problem most often manifests itself.

If, by now, you get our drift, you should understand just how critical it is for your system to have a reliable PSU with plenty of power to spare. A PSU that provides too little power, or inconsistent power, can result in fluctuations that cause all manner of bizarre PC behaviors. Such problems are even more common in older, less-expensive, heavily used PSUs, where voltage stability decreases over time.

FC
Tested to Comply
With FCC Standards
FOR HOME OR OFFICE USE
WARNING
HAZARDOUS VOLTAGES CONTAINED WITHIN THIS POWER SUPPLY,NOT USER SERVICEABLE. RETURN TO SERVICE CENTER FOR REPAIR.
WARNUNG
NETZTEIL UNTER GEFÄHRLICHER SPANNUNG. NICHT VOM BENUTZER ZU REPARIEREN. ZUR REPARATUR AN KUNDENDIENST ZURÜCKSENDEN.
6LL00252 MC

Even if it's unplugged, don't open your PSU's cover for a tinkering session. These components can store dangerous levels of electricity even without a continuous power source. This is a safety warning—and you've warned.

Power In Motion

All of this information is next to worthless unless you can put it to use. What's the best way to monitor the power consumption of the devices that tax your PSU? You can forget using software, such as the utilities that come bundled with motherboards, or any program that looks to motherboard-mounted chips for guidance. These programs are notorious for their inaccuracies.

The most precise way to check the power levels in your system is to use a digital tool that connects to the PSU. Unfortunately, these tools cost upward of $100 and are thus impractical for average users.

However, you can crunch a few numbers to get a rough idea of how much power your system needs. The math is pretty basic. For instance, one of our Samsung optical drives had a label that indicated its power needs (5V at 1.2A/12V at 1.5A). We multiplied the 5V by 1.2 and the 12V by 1.5 and, when those numbers were added together, came up with 24, which meant this drive needed about

Buying Tips

Those 250W PSUs are practically ancient history. For a midrange system that includes a Pentium 4 processor and a standard range of peripherals, you should opt for at least a 300W PSU from a brand-name vendor. If you use a faster processor and a high-end graphics card such as ATI's Radeon 9800 Pro, go for at least a 400W PSU. If you're into overclocking high-end parts, buy the best PSU you can afford. It's a solid investment, and a brand-name product from Antec, Zalman, or another reputable company won't become obsolete as fast as most PC parts.

As you shop, keep in mind that your PSU will have to adhere to a form factor that matches your PC case and motherboard. This list shows that ATX form factor power supplies work with specific products.

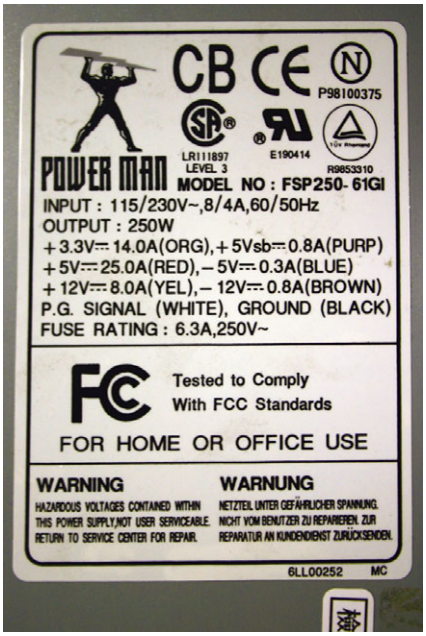
Case Form Factors:
ATX, Mini-ATX, Extended ATX, NLX, microATX, AT/ATX Combo

Motherboard Form Factors:
ATX, Mini-ATX, Extended ATX, NLX, microATX, FlexATX ▲

24W, about average for this type of drive. Repeat this math for every component in your system and you can estimate the kind of wattage you need.

While you're doing this math, you will have to keep the type of voltage in mind, as well. For instance, if your 300W PSU provides 12V at a maximum of 15A, you certainly don't want to add so many 12V components that you exceed 180W of 12V power. In fact, you won't want to approach those numbers because PSUs do their best work when the components they're linked to use about 30 to 70% of maximum potential power.

Finding the power requirements for many devices, such as drives, is easy. But pinpointing the power needs of motherboards, RAM, and other components is often much more difficult. AMD provides broad power guidelines (www.amd.com/us-en/assets/content_type/white_papers_and_tech_docs/26003.pdf) on its Web site. Because few companies offer frequently updated power specs, this document is fairly old, but it's still useful for getting a broad overview of power needs.


CB CE N
P98100375
POWER MAN
MODEL NO : FSP250- 61GI
INPUT : 115/230V~,8/4A,60/50Hz
OUTPUT : 250W
+3.3V⎓ 14.0A(ORG),+5Vsb⎓ 0.8A(PURP)
+5V⎓ 25.0A(RED),-5V⎓ 0.3A(BLUE)
+12V⎓ 8.0A(YEL),-12V⎓ 0.8A(BROWN)
P.G. SIGNAL (WHITE), GROUND (BLACK)
FUSE RATING : 6.3A,250V~
Tested to Comply
With FCC Standards
FOR HOME OR OFFICE USE
WARNING
HAZARDOUS VOLTAGES CONTAINED WITHIN THIS POWER SUPPLY,NOT USER SERVICEABLE. RETURN TO SERVICE CENTER FOR REPAIR.
WARNUNG
NETZTEIL UNTER GEFÄHRLICHER SPANNUNG. NICHT VOM BENUTZER ZU REPARIEREN. ZUR REPARATUR AN KUNDENDIENST ZURÜCKSENDEN.
6LL00252 MC

PSUs include a simple label that indicates how much total wattage they can provide, although some companies are less than honest when it comes to these specifications. Stick with well-established brands to ensure you get what you pay for.

Overload Time

We decided to test two PSUs to see how much punishment they could take when we pressed them to their limits. We started with a basic system that included an ASUS A7V600 motherboard, AMD Athlon XP 3000+ CPU, 512MB RAM, 160GB SATA hard drive, Chaintech GeForce FX 5200 (256MB) graphics card, as well as a CD-ROM and floppy drive, and keyboard and mouse. Electricity came courtesy of a 300W Antec PSU.

Using our handy power consumption chart (see sidebar), we estimated that these components would use anywhere from about 190 to 260W. Because most of our components are relatively new, and thus, more power hungry, we estimated our power usage at closer to the higher number. If you use cutting-edge parts , you'll want to err on the side of caution and do extra research on your power needs. For example, although slower AMD CPUs use around 70 to 75 watts, the company's Athlon 64 CPUs need closer to 90 watts.

We began testing by attaching one, two, three, and then a total of four optical drives to our PSU. That's when our system went haywire. We encountered random restarts, applications that stopped responding, and other bizarre behaviors. After unplugging one optical drive, things seemed normal until we ran 3DMark03, which halted after less than a minute; removing one more drive let this application complete its tasks.

We swapped our 300-watt PSU with a cheap, no-name 250-watt PSU to see if we could overload it. After connecting three optical drives, we noticed that our program operation slowed down, but we kept piling on the extras until we had six optical drives, three hard drives, and more; still 3DMark did run, though very choppily. In spite of all these power-hungry devices, the PSU never did blow.

Pull The Plug

Our experiences with PSUs demonstrated that power problems definitely start to affect a PC's operation once you approach its load limits. The lesson is, of course, that you should never try to run your souped-up PC without an equally nice PSU, otherwise you're asking for a range of troubles that will make your PC experiences less productive and more frustrating. CPU

by Nathan Chandler

Installing A New PSU

Upgrading a PSU is relatively inexpensive, and provided you don't mind messing with a tangle of power cords, pretty easy to accomplish in 10 minutes or so. If you don't often disassemble and reassemble PCs, make sure you take a look at where each connector of your current PSU goes. You'll see that 4-pin connectors affix to the rear of optical and hard drives, a smaller connector attaches to the floppy disk drive, and that at least one and possibly two connectors go to the motherboard.

After you note the position of each connector, go ahead and disconnect them. Then loosen the screws that secure the PSU to the case. These screws are usually on the back side of the case. As you remove the last screw, make sure you have a hand on the PSU so it doesn't fall onto a delicate component, such as your motherboard, where it can cause catastrophic damage. Some cases with a cramped interior might make it difficult for you to wiggle the PSU free, especially if an optical drive gets in the way. If this happens to you, just slide the drive out of the way until there's enough space to remove the PSU.

Retrieve your new PSU and slide it into place. Secure it with all four screws to make sure it stays put and then make all necessary power connections to your PC's components. Try to keep the wiring as neat as possible by using plastic zip ties or cable organizers, as doing so will improve airflow in the case and reduce the chances of wires becoming snagged in case or CPU fans. ▲

Thermaltake Xaser III Super Tower V1420DU

We got our hands on Thermaltake's blue V1420DU, which features a clear plexi window and a 420W Silent PurePower PSU. The most striking feature of this premod is the blue anodized aluminum front bezel with brushed aluminum accents. The front panel's blue Thermaltake EL LED light further adds to the case's aesthetic appeal.

Thermaltake stays true to its name by including the Hardcano four-channel fan-speed controller, which displays the ambient case and CPU temperatures, and lets you independently adjust the fan speeds on up to four channels at once.

All told, seven 80mm Thermaltake ultra-silent fans populate the Xaser III, four of which are intake and three are exhaust. The two front- and two side-panel intake fans each have removable air filters. Be warned, seven "silent" fans running at 2,900rpm are anything but silent. The Xaser III comes with the unique Side-Fan Panel, which is a hinged plastic door that houses the side fans and snaps in place over the motherboard.

The high-grade steel chassis and panels are thick enough to protect your components from a direct mortar blast, but all that heavy metal will take its toll on your back should you decide to lug your Xaser III to a LAN party.

Xaser III Super Tower V1420DU
$155 (W/PSU)
Thermaltake
(800) 988-1088
(626) 968-9189
www.thermaltake.com

The top panel features a fan vent and spare USB and FireWire ports, as well as mic and headphone jacks. The USB ports each have a single connector, while the FireWire, mic, and headphone connectors are separated out by pin.

The front-panel connector plugs are colored and clearly labeled, which makes connecting them to the motherboard headers that much easier. The case also features a case-open alarm, should you install a motherboard that supports that function. Thermaltake also included wide clips to keep your IDE and floppy ribbon cables from blocking airflow.

Two of the six internal 3.5-inch drive bays are occupied by plastic racks that hold the tool-free 5.25-inch and 3.5-inch drive rails. We were impressed by the ease with which drives slid and locked into place using the toolless drive rails.

The seven toolless PCI slots feature plastic locking mechanisms that lift and slide out to allow room for the wide part of the PCI card bracket. The latch wasn't nearly as secure as a screw. Fortunately, Thermaltake lets users remove the toolless latches and use screws.

The Xaser III Super Tower is a quality case with enough fan power for moderate overclocking or just worry-free computing in any climate. Enthusiasts that make a practice out of constantly exchanging components will appreciate never having to touch a screwdriver, and the killer looks don't hurt either. CPU

by Andrew Leibman

Basic Specs
Form Factor(s): Super Tower (Micro ATX,Standard ATX, Extended ATX)
Construction Material: Steel chassis/aluminum front bezel
Dimensions: 21.2 inches high x 8 inches wide x 22.2 inches deep
Weight: 41.58 lb
Power Supply: 420W Silent PurePower
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 4 (top bay loaded with fan controller)
Description: Front entry with drive rails
3.5-inch (HDD)
Drive cages: 3 (1 external, 2 internal)
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? Yes (front bezel/side panel)
Description of side panel: Windowed/vented
Description of front panel: Aluminum door, LED logo, Hardcano 4 Fan Speed Controller
Fans: 7 (4 intake, 3 exhaust)
Vents: 6 (2 Side Panel, 1 Top Panel, 1 Front Bezel, 2 Rear)
Additional cooling: Dual-fan PSU
Top Panel Ports
Top USB ports: Yes (2)
Top FireWire ports: Yes (1)
Top microphone jack: Yes
Top headphone jack: Yes
Final Word
Target Market: Enthusiasts and gamers.
Pros: The Xaser III has lots of fans, plenty of interior room regardless of mobo form factor, and tool-free everything.
Cons: All those fans make this one noisy beast, and the Xaser III case alone weighs more than most complete PCs.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Raidmax Scorpio 668W

Scorpio 668WBP
$99 (W/PSU)
Raidmax
(626) 337-6669
www.raidmax.com

The Scorpio 668W is a premodded gaming case composed of ultra-light 1mm gauge aluminum, so you should have no trouble showing up at LAN parties with your Scorpio in tow.

The Scorpio's front panel is reminiscent of the popular Xaser III, with the Scorpio's "Z" logo playing off of Thermaltake's "X" logo. The door of the plastic front bezel features a blue LED that lights the "Z" logo and two half-moon-shaped LEDs, one above and one below the logo. Behind the door, the Scorpio features five 5.25-inch bays and two 3.5-inch bays.

The lower half of the front bezel acts as a vent for the two front intake fans and looks similar to the vents on popular Chenming and Antec cases. Raidmax also supplied a front-bezel lock and two keys.

The side panels secure to the chassis with thumbscrews for tool-free entry, but once inside, you'll need a screwdriver to install your components.

Six 80mm fans exchange the air inside this case. The two clear exhaust fans in the back feature thermal diodes. The purple top-panel fan exhausts through the plastic top-panel assembly. The black front-bezel fans are 15mm deep and work as the case's lone intake fans. The clear exhaust window fan features three red LEDs, a fan grill, and a wire-mesh filter.

The premodded side panel features a full-sized window that lets you see just about everything inside your case. Raidmax didn't include any cable clips or nylon ties, so managing the wiring may prove difficult; hiding it is just about impossible.

The top-panel USB, FireWire, and audio ports are accessible from a push-button lid. The FireWire, mic, and headphone connectors are separated and labeled by pin, which makes them compatible with any motherboard. The two USB ports each have a single connector.

Two screws and six clips hold the removable motherboard tray in place.

The Scorpio has five internal 3.5-inch drive bays, each of which secures to a noise buffered drive tray. The 5.25-inch drive cage supports five devices with the 10 screw-mounted drive rails. The external 3.5-inch "tray" seemed flimsy but was a lot more solid after we installed a floppy drive.

Basic Specs
Form Factor(s): Mid Tower (Micro ATX, Standard ATX)
Construction Material: Aluminum
Dimensions: 20.5 inches high x 8 inches wide x 18.5 inches deep
Weight: 14.92 lb
Power Supply: 420W RAIDMAX
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 5
Description: Front entry with drive rails
3.5-inch (HDD)
Drive cages: 2 (1 external, 1 internal)
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? Yes (front bezel)
Description of side panel: Windowed/built-in fan
Description of front panel: Plastic Door, LED Logo and HD Activity LED, vent for intake fans
Fans: 6 (2 intake, 4 exhaust)
Vents: 5 (1 side panel, 1 top panel, 1 front bezel, 2 rear)
Additional cooling: Dual-fan PSU
Top Panel Ports
Top USB ports: Yes (2)
Top FireWire ports: Yes (1)
Top microphone jack: Yes
Top headphone jack: Yes
Other front ports/controls: N/A
Final Word
Target Market: Enthusiasts and gamers.
Pros: The Scorpio 668 has lots of fan power, a removable motherboard tray, and a lightweight construction.
Cons: PCI fingers and external 3.5-inch tray are rather flimsy. We would've liked to see a few more toolless features and an installation guide.

Raidmax bills the Scorpio 668 as a low-cost alternative to other popular cases, but what the Scorpio lacks in originality, it makes up for in its lightweight construction and builder-friendly features. CPU

by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Cooler Master Centurion 5

Centurion 5 CAC-T05-WBA
$98 (with PSU)
Cooler Master
(909) 673-9880
www.coolermaster.com

The Centurion 5 has a commanding presence with its matte-black chassis, blue anodized aluminum, and black mesh front bezel.

The naked steel chassis is unpainted, but the side panel's window is narrow enough that only about 2 inches of the 5.25-inch drive cages are visible. The window features a small Cooler Master logo in the upper-right corner and a prominent Centurion logo in the center.

The Centurion 5 doesn't feature a horizontal beam to support the PSU, and as a result, this case has generous amounts of room for installing your components.

The 120mm rear exhaust fan can push more air at much lower rpms than smaller fans. The 80mm front-intake fan uses the foam-lined front panel for a vent and filter.

We definitely would've preferred a hinged and lockable front panel, but you should only need access to the front side of the chassis when initially removing the drive bay covers. After resetting the front panel, we slid our optical and floppy drives in from the front. The drive bays feature a rather unique locking mechanism that holds the drives securely in place with a horizontally sliding plastic rail and a vertically sliding tab.

The top toolless PCI slot was free, so we disengaged the black plastic latch that covered the front end of the slot and inserted a graphics card. We reset the latch, which locked the card down tight; however, you can use the exposed screw hole to bolt the card to the chassis the old-fashioned way if you're not convinced.

The front panel features two USB ports, a mic jack, a headphone jack, and one FireWire port. The gray sleeved connectors for the mic and headphone ports are separated and each pin is labeled, which makes them compatible with just about any motherboard's audio headers. Both the USB and FireWire connectors are standardized, and each utilize a single plug.

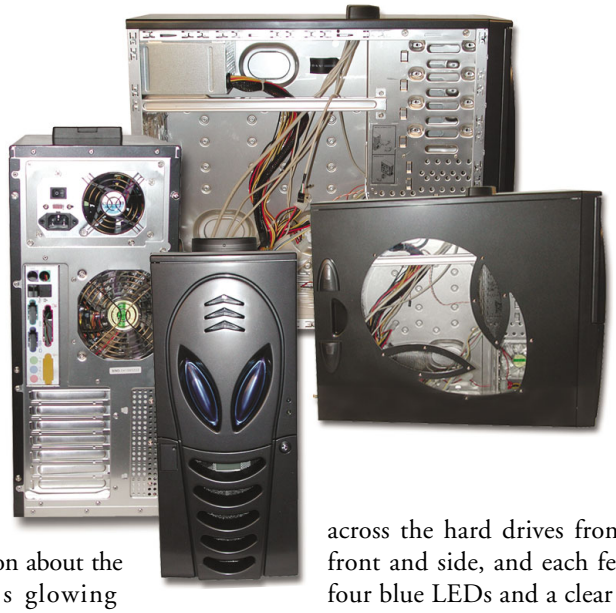
From a company named Cooler Master, we expected a more overclocking-friendly case in the Centurion 5. Overclocking aside, this case is great for frequent builders and gamers more concerned with noise output and solid construction. CPU

by Andrew Leibman

Basic Specs
Form Factor(s):
Mid Tower:
(Mini ATX, Micro ATX,Standard ATX)
Construction Material:
Steel chassis/aluminum front bezel
Dimensions:
19 inches high x 8 inches deep x 17.1 inches wide
Weight: 20.44 lb
Power Supply:
350W Cooler Master
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 5
Description: Toolless front entry
3.5-inch (HDD)
Drive cages: 1
Drive adapters: N/A
Expansion slots:
5 (1 external bay, 4 internal bays)
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? No
Description of side panel:
Windowed/Centurion Logo
Description of front panel:
Annodized blue aluminum frame, metal mesh face, metal Power/Reset buttons, exposed front panel ports (USB, FireWire, Mic, Headphone)
Fans: 2 (1 intake, 1 exhaust)
Vents:
3 (1 rear, 1 front bezel, 1 side panel)
Additional cooling:
Single-fan PSU
Front Ports
Front USB ports: Yes (2)
Front FireWire ports: Yes (1)
Front microphone jack: Yes
Front headphone jack: Yes
Final Word
Target Market:
Enthusiasts and gamers.
Pros:
The Centurion 5 is quieter than other fan-loaded cases, and you'll only need a screwdriver for installing the motherboard.
Cons:
One intake fan, one exhaust fan, and a single-fan PSU may not be enough to cool your overclocked components.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

A-Top Technology Z-Alien



Z-Alien
$139 (W/PSU)
A-Top Technology
(909) 595-3333
www.a-top.com

Our initial observation about the Z-Alien's glowing LED alien eyes and alien side panel window was "gamer cliché run amuck."

The case is made of aluminum, with the side panels painted a glossy metallic charcoal. The windowed panel's alien eyes are covered in metal mesh and act as air vents. The plastic front bezel's door flips open to reveal six drive bays (four 5.25-inch, two 3.5-inch), the power and reset buttons, and the hard drive activity and power LEDs. The bezel locks to the chassis front with a key, but you'll have to install the inner latch first.

The Accessories Kit is mounted to the floor of the case and houses the toolless drive rails. We snapped two of the metal rails (labeled L for left and R for right) to our CD-ROM drive, removed the bay cover, and slid the drive in place. We followed the same procedure for installing a floppy drive, using the designated plastic rails. The hard disk drive also went in as easily.

The two 80mm intake fans blow across the hard drives from the front and side, and each feature four blue LEDs and a clear plastic mesh filter. The rear exhaust is powered by a 120mm fan that features four blue LEDs.

The Z-Alien has two front-panel USB ports, as well as a top-panel hub that features two more USB ports, a mic jack, a headphone jack, and one FireWire port. Each of the four USB ports feature 4-pin plugs, while the top-panel FireWire, mic-in, and audio-out plugs are separated out and labeled by pin. The case also includes an alarm mechanism, if you install a motherboard that supports case-intrusion detection.

The back-panel PCI brackets feature stabilizing clips, which slide back and forth to allow for the toolless insertion and removal of AGP and PCI expansion cards.

The side panel came out of the box dented, which had us wondering if the case had shipped from a crash-site in Roswell. Despite its cheesy exterior, the Z-Alien has a number of innovative features that make this a superior case for gamers and enthusiasts alike. CPU

by Andrew Leibman

Basic Specs
Form Factor(s): Mid tower (Micro ATX, Standard ATX)
Construction Material: Aluminum chassis/plastic front bezel
Dimensions: 18.7 inches high x 8.2 inches wide x 22.5 inches deep
Weight: 16.26 lb
Power Supply: 500W
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 4
Description: Front entry with drive rails (front bezel must be removed first)
3.5-inch (HDD)
Drive cages: 2 (1 external, 1 internal)
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? Yes (front bezel)
Description of side panel: Windowed/convexed vent grilles
Description of front panel: Plastic door/bezel, blue LED Alien Eyes, blue LCD temp display
Fans: 3 (2 intake 1 exhaust)
Vents: 5 (3 side panels,1 front bezel, 1 rear)
Additional cooling: N/A
Front Ports
Front USB ports: Yes (2)
Other front ports/controls: N/A
Top Panel Ports
Top USB ports: Yes (2)
Top FireWire ports: Yes (1)
Top microphone jack: Yes
Top headphone jack: Yes
Final Word
Target Market: Enthusiasts and gamers.
Pros: The Z-Alien's three sleeve-bearing fans make for a quiet computing experience, and frequent tweakers will appreciate the tool-free design.
Cons: Three case fans may not be sufficient to cool your gear. We broke two of the case feet retention clips trying to install them, but luckily they screw in place.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Aspire X-Dreamer II

X-Dreamer II
$54 (W/PSU)
Aspire
(626) 912-1266
www.aspireusa.net

The X-Dreamer II is a steel case with metallic silver side and top panels. The interior of the case is bare unpainted steel with curved and folded edges. The front bezel is silver and features a semitransparent blue acrylic face. The top two 5.25-inch drive bays have spring-mounted bay doors, which you can use to hide your unmatched optical drives. Fortunately, not all of the drive bays have doors, so you can install other devices such as fan controllers and temperature gauges.

Two thumbscrews hold the windowed panel in place, but beyond that, you'll need a screwdriver to do anything in this case. We had to remove both side panels to remove the screws that held the front bezel to the chassis.

We had a little difficulty installing 3.5-inch drives due to the warped drive cage, but we pulled on the sides of the drive cage to reshape the metal, which allowed the drives to slide in and out more freely.

A built-in 80mm blue LED fan adorns the upper-left corner of the side panel's window and acts as the case's sole intake. The top panel features an 80mm blue LED exhaust fan. The bundled 350W PSU only has one fan, which leaves this case slightly lacking when compared to the other air-cooled cases we tested. Aspire does give us the option to add two more 80mm fans to the front panel and up to a 120mm fan on the back panel.

The X-Dreamer's front bezel features two USB ports, a microphone-in jack, and an audio-out jack. The two USB ports have separate cables and plugs, each with labeled pin designations. The mic-in and audio-out jacks terminate in 3.5mm miniplugs for motherboards that don't support internal audio headers.

The front panel's most prominent feature is the blue backlit LCD temperature display, which features power and reset buttons to the right, and power and hard drive activity LEDs to the left. The temperature probe has a flat flexible tip that you can affix either near the CPU or in an open-air location to display the ambient case temperature.

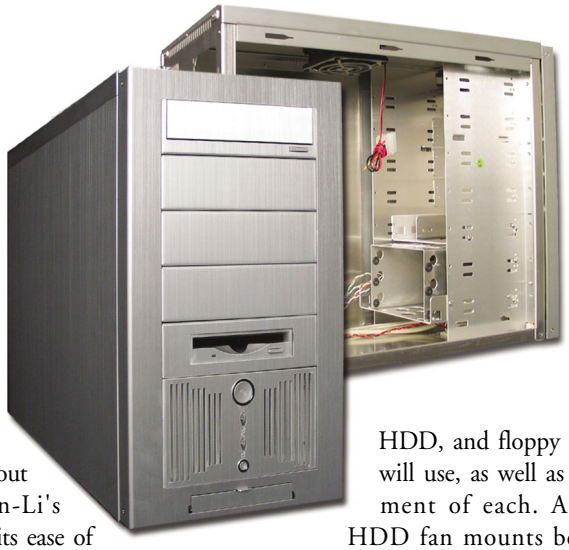
Basic Specs
Form Factor(s): Mid tower (Micro ATX, Standard ATX)
Construction Material: Steel chassis/plastic front bezel
Dimensions: 17 inches high x 7.8 inches wide x 18.6 inches deep
Weight: 16 lb
Power Supply: 350W
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 4
Description: Screw-mounted front entry
3.5-inch (HDD)
Drive cages: 2 (1 external, 1 internal)
Drive adapters: N/A
Expansion slots: 6
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? No
Description of side panel: Windowed/LED fan with Alien Logo grille
Description of front panel: Blue plastic, silver drive bay doors and covers, power and reset switch, LCD display, front anel USB and audio ports
Fans: 2 (1 intake, 1 exhaust)
Vents: 5 (1 front, 2 side panels, 2 rear)
Additional cooling: N/A
Front Ports
Front USB ports: Yes (2)
Front FireWire ports: N/A
Front microphone jack: Yes
Front headphone jack: Yes
Final Word
Target Market: Enthusiasts and gamers.
Pros: This is one of the cheaper cases you'll find that isn't cheaply built.
Cons: Not much in the way of builder-friendly features.

Aspire's X-Dreamer II is an attractive case with some appealing features. We imagine a frequent builder might get frustrated with the X-Dreamer's lack of tool-free options, but gamers and enthusiasts looking for an affordable no-nonsense premod won't be disappointed. CPU

by Andrew Leibman

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Lian-Li PC-3077A



PC-3077A
$109.95
Lian-Li
02-24513000
(Taiwan)
www.lian-li.com

Two things that stand out about Lian-Li's PC-3077A case are its ease of use and flexibility. It has toolless entry, easy-to-remove side panels, and adjustable drive bays.

To remove the front panels, you only need to remove thumbscrews from the back of the case and slide the panel away. It requires little effort to get the panel back on its track and latched into place later.

Lian-Li gives you a lot of freedom to arrange your HDD, ODD, and floppy drives. The front panel of the case is removable, exposing one ODD drive bezel, three ODD bay covers, one floppy-drive bezel, and a vented piece that houses the power and reset buttons and status LEDs. Each of the bezels and covers fits over any of the case's seven 5.25-inch drive bays; the vented piece covers any two adjacent bays.

The included 3.5-inch adapter tray converts one of the 5.25-inch bays into housing for either a hard or floppy drive. A three-drive 3.5-inch cage is also included and mounts in any two adjacent 5.25-inch bays.

The movable front pieces, drive cage, and 3.5-inch adapter give you considerable freedom to choose the number of ODD, HDD, and floppy drives you will use, as well as the placement of each. A bundled HDD fan mounts behind the front vent. The PC-3077A also has a blowhole for better air circulation.

Despite its small size (14.4 inches high x 8.3 inches wide x 19.3 inches deep), this case offers considerable expansion options through its seven slots for expansion cards. Front ports include one microphone jack, one 1/8-inch headphone jack, two Hi-Speed USB 2.0 ports, and one FireWire port.

Finally, the PC-3077A's power-supply tray is removable. This is a blessing because the power supply mounts directly in front of the motherboard, blocking access to the CPU and heatsink.

We really like how flexible this case is and how smoothly the side panels slide on and off. Although the panels are easy to remove, once attached, they are quite secure. As long as our system wouldn't require frequent tinkering with the CPU or heatsink, we would gladly choose this case to house one of our own PCs. CPU

by Kylee Dickey

Basic Specs
Form Factor(s): ATX (12-inch x 9.6-inch maximum)
Construction: Aluminum
Dimensions: 14.4 inches high x 8.3 inches wide x 19.3 inches deep
Weight: 10.14 lb
Power Supply: N/A
Drive Bays & Expansion Slots
5.25-inch (ODD): 4
Number of external bays: 7 total, 5 accessible (front vent covers 2 of the 7 bays). Only 4 5.25-inch bays accessible if both drive cage and 3.5-inch drive adapter are used.
Mounting mechanism: Drives screw into nonremovable bays
3.5-inch (HDD)
Drive cage: 1 antivibration 3-drive cage that fills 2 5.25-inch bays
Drive adapter: 1 3.5-inch HDD/floppy adapter tray that fills 1 5.25-inch bay
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes (2 thumbscrews on each side panel)
Description of side panel: Solid brushed aluminum
Description of front panel: Removable brushed aluminum panel, 1 ODD drive bezel, 3 ODD bay covers, 1 floppy-drive bezel, adjustable vent, power button, power LED, drive-access LED, reset button, and small flip-open door, which conceals front ports
Fans: 1 front HDD fan (adjustable), 1 blowhole
Vents: 2 (for HDD fan and blowhole)
Front Ports
Front Hi-Speed USB 2.0 ports: 2
Front FireWire ports: 1
Front microphone jack: 1
Front headphone jack: 1
Final Word
Target Market: Home users, users who desire quick and easy access to most components (CPU and heat sink excluded).
Pros: Nice collection of front USB ports, 7 expansion slots, a front HDD fan and vent, a blowhole, 1 5.25-inch drive bezel and 1 floppy drive bezel, and exceptionally easy-to-open panels.
Cons: Small design. Have to remove power supply to access most components on motherboard (however, the power-supply tray is removable). Unlike other cases we reviewed, this one does not include a lock or other security device.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Antec Performance Plus1080AMG

Antec's Performance Plus1080-AMG case does not stand out. In fact, it looks like most other SOHO ATX towers. However, this case has a few unique features.

The most significant features are the chassis material and bundled 430W Antec TruePower power supply. The Plus-1080AMG is made of 1mm steel, making the case both sturdy and heavy (over 30 pounds empty). Don't expect to lug this case to a LAN party unless you're Arnold Schwarzenegger.

Most of the case's internal components are made of steel, too. The expansion slot plate, ODD drive bays, and HDD drive cages will stand up to some abuse, although we doubt you'd willingly abuse this case.

Performance Plus1080AMG
$159
Antec
(888) 542-6832
(510) 770-1200
www.antec.com

Antec's TruePower devices adjust the speed of power-supply fans according to the power usage. When a PC uses less power, the power-supply fan spins slower, resulting in less fan noise. Case fans connected to the power supply's Fan Only connectors also benefit from TruePower fan monitoring and speed adjustment.

The Plus1080AMG provides two rear fans and one side-panel fan. The provided clip-in fan brackets let you add a front fan and an HDD fan. The front of the case has a removable air filter that you can wash to maintain the most effective airflow and lowest system temperatures.

Drive installation is relatively painless. Four pairs of drive rails are included for the four 5.25-inch drive bays. After connecting a pair of drive rails to a bay, we simply pressed the drive into the case until it locked into place. Hard drives mount in the two supplied three-drive cages. A set of drive screws secures drives in place, and the cages lock into the front of the case.

While most of the case's components hold up well against rough treatment, we had trouble even attaching the front door without breaking it. The upper-left corner of the door will break easily at the hinge, so take extra caution when you're attaching or removing the door.

As a server case, the Plus-1080AMG includes locks for the front door and side panel. Two keys come with the case. The server design also ensures that you'll have plenty of room to work inside the case. There is only one exception. If you want to install more than three 3.5-inch drives and a video card, you'll probably find that the back of the drives or SATA adapters (if you use them) butt up against the video card. There should be room to install everything, but airflow will be somewhat restricted, so you will probably want to take advantage of the case's empty fan brackets.

Overall, this is one of the sturdiest and most spacious cases we've seen. The 430W TruePower power supply is also a nice touch. For any SOHO or home environment, this is an excellent case that makes it easy to install drives, work with components, and control system temperature. The only users who should really object to this case are those who want a prettier case or a LAN party case. CPU

by Kylee Dickey

Basic Specs
Form Factor(s): ATX form factors up to Extended ATX
Build Material: steel
Dimensions: 20.6 inches high x 8.1 inches wide x 18.6 inches deep
Weight: 31.3 lb
Power Supply: Antec TruePower 430W
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 4
Description: Drives mount using the included drive rails
3.5-inch (HDD)
Drive cages: 2 3-drive 3.5-inch drive cages
Drive adapters: N/A
Built-in bays: N/A
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? Yes (front door and side panel)
Description of side panel: Solid gray with black handle and silver lock
Description of front panel: Solid gray with washable air filter on the lower portion of the panel and a locking door on the upper portion of the panel. The door covers the 5.25-inch optical and external 3.5-inch drive bays.
Fans: 2 rear fans, 1 side-panel fan
Optional: 1 front fan, 1 HDD fan. Supported fans: Up to 5 x 80mm.
Vents: Washable air filter on front of case
Additional cooling: N/A
Front Ports
Front Hi-Speed USB 2.0 ports: 2
Front Full-Speed USB ports: 0
Front FireWire ports: 1
Front microphone jack: 0
Front headphone jack: 0
Other front ports: N/A
Final Word
Target Market: Those who need a SOHO server or a home PC that has good airflow and plenty of room in which to work when tinkering with components.
Pros: With 6 3.5-inch bays and 4 5.25-inch bays, this case has plenty of room for adding drives. The included 430W power supply adds considerable value to a roomy and rugged case. With 3 fans preinstalled and 2 more optional, there are plenty of ways to keep the system cool. Adding and removing drives was simple, with only the HDD installation requiring a screwdriver.
Cons: The front door breaks off very easily and is the only component of this case that isn't quite sturdy. Although most users will find the Plus1080AMG very roomy, if you want to install all 6 3.5-inch drives and a video card, you may find space and airflow to be an issue.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Chenming 601 Aluminum Silver

At first glance, Chenming's 601 Aluminum Silver case looks very similar to Antec's Performance Plus1080AMG case. However, there are several differences between Chenming's and Antec's offerings.

With its aluminum construction, this case is a lot lighter (just 13 pounds) than Antec's Plus1080AMG. The Chenming case could realistically accompany you to a LAN party, whereas the Antec case could not. If you'd rather have a sturdy case than a light case, though, the Chenming 601 Steel (made of 1mm steel) is also available and weighs 30 pounds.

The Chenming case we reviewed lacks an included power supply and a side-panel fan. However, various side panels are available for the 601, including one with a window and fan. The case comes in a plethora of colors.

The interior of the 601 is identical to the Plus1080AMG. It has four 5.25-inch drive bays. Conveniently, you can install optical drives externally after installing the included drive rails. The 601 also comes with two three-drive 3.5-inch drive cages. The top two 3.5-inch bays provide external access for floppy drives. Although you'll need drive screws to mount the drives, the cages themselves are equipped with latches for tool-free installation.

The front panel of the 601 has four 5.25-inch bay covers, two 3.5-inch bay covers, two Hi-Speed USB 2.0 ports, and one FireWire port. The lower half of the front panel is vented for better airflow. Whereas the front panel of the Antec Performance Plus1080AMG had LEDs for power, hard drive, and two floppy drives, the Chenming 601 has only two LEDs, one for power and one for hard drive access.

Two 80mm rear fans come installed in the 601, and two clip-on fan mounts are included to add a front-panel fan and an HDD fan. Finally, there are seven expansion slots for adding AGP, PCI, and other expansion cards.

601 Aluminum Silver
Chenming
$69.99
(780) 463-3838
www.chenming.com

The 601's side panel opens using a built-in black plastic handle. A pair of thumbscrews can add extra support for the side panel, but they are not really necessary. Also, both the side panel and front door of the 601 have a built-in lock.

At 19 inches deep, there is a lot of room inside this case, making it easy to install memory, swap processors, add a new video card, and make other changes. As we mentioned with the Antec Performance Plus1080AMG, however, 3.5-inch drives in the upper bays may come close to nudging the edge of an AGP card, resulting in airflow restriction. In this situation, you might install both optional fans and buy the optional side panel with fan.

This case isn't as rugged as the Plus1080AMG, but it does provide many of the same benefits. The Chenming 601 offers more room than most users will need to work inside the case, a pair of installed rear fans, plenty of drive bays, seven expansion slots, and a locking front door and side panel. Finally, the Chenming 601 comes in both aluminum and steel and offers several optional side panels. CPU

by Kylee Dickey

Basic Specs

Form Factor(s): ATX form factors up to 12 inches x 13 inches

Construction Material: aluminum

Dimensions: 21 inches high x 8 inches wide x 19 inches deep

Weight: 13 lb

Power Supply: N/A

Drive Bays & Expansion Slots

5.25-inch (ODD)

Quantity: 4

Description: 5.25-inch drives lock into bays using bundled drive rails

3.5-inch (HDD)

Drive cages: 2 three-drive cages (2 external bays, 4 internal bays)

Drive adapters: 0

Built-in bays: 0

Expansion slots: 7

Panels, Windows & Fans

Toolless entry? Yes

Locking panels? Yes

Description of side panel: Solid aluminum with black plastic handle and silver lock

Description of front panel: Vent on bottom half, front door on top half

Fans: 2 80mm rear fans included, fan clips for 1 optional front 80mm fan, and 1 optional HDD fan

Vents: Front vent

Additional cooling: N/A

Front Ports

Front Hi-Speed USB 2.0 ports: 2

Front Full-Speed USB ports: 0

Front FireWire ports: 1

Front microphone jack: 0

Front headphone jack: 0

Other front ports: 0

Special Features

Removable motherboard tray? No

Carrying handle? No

Security hook? No

Accessories: 8 drive rails, 2 fan clips for optional fans

Other stand-out features: Optional side panel with fan, optional side panel with clear window, optional intrusion-sensing switch, external ODD installation

Final Word

Target Market: Systems that require multiple 3.5-inch drives, basic servers, case mods

Pros: This aluminum model is lighter than Antec's Plus1080AMG case. Users who want a more rugged case can choose the 601 Steel. Chenming also offers this case in many colors and with many optional side panels. The case is roomy, and parts are easy to install.

Cons: The aluminum construction isn't as sturdy as the steel construction, but a 601 Steel model is available. This base model doesn't include a side-panel fan, but again, one is available as an option for this case.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

ENERMAX CS-5190AL

The ENERMAX CS-5190AL case drew more than a few glances in our hardware testing lab. In fact, most people didn't just look; they gawked. We think it's inevitable: If you build a system using the 5190AL, with its unique design and car-level finish, your computer will be more popular than you are.

CS-5190AL
$ 182
ENERMAX
(888) 363-7629
(626) 913-8899
www.maxpoint.com

Among the case's greatest assets is its supply of fans: two 60mm rear fans, an 80mm front fan, and two fans (one 80mm and one 120mm) mounted on the side brackets. You can add another 80mm and another 120mm fan to the side brackets. You can control three of the fans by connecting them to the three fan-speed control knobs on the front panel of the case. However, only specific ENERMAX-branded fans are compatible.

The front of the case also has a small LCD (to display the system temperature), audio ports (audio-in, audio-out, and microphone), two front USB ports, a FireWire port, a volume control dial, and a game port.

The front of the case slants toward the back, which, although aesthetically pleasing, places the four 5.25-inch bays and the external 3.5-inch bays at an approximate 15-degree slant. Although we didn't notice any disc-burning errors or other major problems, we would suspect that over time, the crooked positioning could shorten the life of drives. We would suggest installing hard drives in the lower three internal 3.5-inch bays, which are not tilted.

Also, the vented acrylic window is attached to the black aluminum side panel with a weak adhesive and blue tape. It takes only a bit of force to push the window out. It's even possible that the adhesive may shift when system temperatures rise.

The side panel is held on with four screws; there's no sliding or latching of the panel. It's convenient, but after you remove the last screw, the side panel falls off, so be ready to catch it. The motherboard tray is removable for easy access to the board. You will, however, have to remove the expansion slot that connects to the front-port PCB before you can pull the tray out.

ENERMAX includes a small plastic box with assorted screws sorted in compartments. This was much better than finding the usual plastic bag of unsorted screws. Four caster wheels are included if you'd like your case on wheels.

We have mixed feelings about the CS-5190AL case. It has many great features, such as fan-speed controls, temperature display, front game port, removable motherboard tray, and support for up to seven fans. On the other hand, in many ways it feels as if ENERMAX cut corners in the name of aesthetics. The angled bezel looks lovely, but we would prefer to mount drives parallel to the ground. The boltless sidepanel window looks glamorous without bolts, but we'd like for it to be secured better. Although the case is beautiful for a gaming system, we'd sacrifice some of the case's beauty for more practicality. CPU

by Kylee Dickey

Basic Specs

Form Factor(s): ATX

Construction Material: Aluminum with car-level finish coating

Dimensions: 16.5 inches high x 7.9 inches wide x 24 inches deep

Weight: 30 lb

Power Supply: N/A

Drive Bays & Expansion Slots

5.25-inch (ODD)

Quantity: 4

Description: Drives screw into bays using bundled drive screws

3.5-inch (HDD)

Drive cages: 0

Drive adapters: 0

Built-in bays: 3 external bays (1 filled by fan-speed control dials and LCD temperature display), 3 internal bays

Expansion slots: 7

Panels, Windows & Fans

Toolless entry? No

Locking panels? No

Description of side panel: Black aluminum border with car-level finish and large, clear window

Description of front panel: Slanted panel with car-level finish, LCD system-temperature display, 3 fan-speed control knobs, and front ports (2 USB, microphone, audio-in, audio-out, volume control, game port, and FireWire)

Fans: 1 80mm front fan, 2 60mm rear fans, 1 80mm fan and 1 120mm fan on side mounting bracket. Optional: A second 80mm fan and a second 120mm fan on side mounting bracket.

Vents: Front vent, vented openings on side window

Front Ports

Front Hi-Speed USB 2.0 ports: 0

Front Full-Speed USB ports: 2

Front FireWire ports: 1

Front microphone jack: 1

Front headphone jack: 1

Other front ports/controls: Audio-in, volume dial, game port, 3 fan-speed control knobs, one system temperature LCD

Final Word

Target Market: A case clearly built for gamers who want to attract some attention.

Pros: Draws attention with its unique design, car-level finish, clear side panel, plethora of fans, temperature display, front fan-speed dials, and front game port. The removable motherboard tray is also an excellent touch.

Cons: We wouldn't trust our DVD, CD, and hard drives in this system's slanted drive bays. Although we could burn a CD in this case without any recognizable errors, the angle of the drive bay will put strain on the drives over time. Also, the side panel's window is attached haphazardly with adhesive and tape.

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

SilverStone Temjin TJ04

Temjin TJ-04
$120
SilverStone
(909) 605-1023
www.silverstonetek.com

We love cases with easy entry and simple design. SilverStone's Temjin TJ-04 provides both of these assets in a chassis that is as attractive as it is user-friendly.

Only a pair of thumbscrews and a side-panel latch secure the case. The case is roomy, and most users will have no trouble finding the space to install components.

One of the only times you'll need a screwdriver while working in this case is when you remove the bay covers. To do this, you only need to remove one screw from each drive bay. The drive rails of the TJ-04 are unique in that they are built into the drive bay rather than separate pieces that you attach to drives. You'll need to slide the drive rail from the Lock position to the Open position, and then you can snap the bay cover off by pressing it from the back of the case. Once you've removed all necessary bay covers, you'll only need your screwdriver to install expansion cards in the seven expansion slots.

It was simple to install optical and floppy drives in this case. After removing a bay cover, we slid a drive into the corresponding bay and slid the drive rail into the Lock position. Working with the four concealed hard drive bays was nearly as straightforward. Internal drives mount in a four-drive cage, which you remove with a few twists of two thumbscrews. Once the cage is out, drives mount the same way the optical and floppy drives did: Slide the drive rail out of the Lock position, place the drive in the bay, and lock the drive rails. To make things even simpler, SilverStone includes a short users manual with excellent photos and better installation instructions than most cases' users manuals.

There are plenty of reasons other than ease of use to like the TJ-04. For example, there are several front ports (four Hi-Speed USB ports, a FireWire port, a microphone jack, and a headphone jack). A 120mm front intake fan is included, and you can choose an optional 80mm, 92mm, or 120mm rear fan.

The TJ-04 supports ATX and microATX motherboards and ATX power supplies. The LEDs on this case are blue rather than red, giving a TJ-04 system a unique appearance. The blue lights match well with the black aluminum front panel and the high-gloss black coating of the side panel. You may wish to add additional lights and attractive cables to your system because the TJ-04 features a large crescent-shaped window that provides a very clear view of the inside of the case. The side-panel locks provide added security for exposed parts.

We've seen cases that provide better overall cooling than SilverStone's Temjin TJ-04, but we haven't seen any that make it so hassle-free to upgrade components, swap drives, or troubleshoot parts. Users who frequently tinker with hard drives, optical drives, memory, and expansion cards will find the TJ-04 a very user-friendly and attractive case. CPU

by Kylee Dickey

Basic Specs
Form Factor(s): ATX, microATX
Construction Material: Steel body, aluminum front panel
Dimensions: 17.6 inches high x 8.5 inches wide x 18.6 inches deep
Weight: 20.3 lb
Power Supply: N/A
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 4
Description: Optical drives slide in from the front of the case. A plastic lock slides into position to secure the drive.
3.5-inch (HDD)
Drive cages: 1 4-drive cage
Drive adapters: 0
Built-in bays: 2 (external)
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes. (Except for removing bay covers, assembly is toolless, as well.)
Locking panels? Yes (side panel)
Description of side panel: Black with crescent-shaped window
Description of front panel: Black aluminum panel with 4 5.25-inch bay covers, 2 3.5-inch bay covers, 2 buttons (Power and Reset), 2 LEDs (Power and HDD), and a small door concealing front ports
Fans: 120mm front intake fan and a rear bay fan (compatible with 80mm, 92mm, or 120mm fan)
Vents: At front, on the underside of the case
Additional cooling: N/A
Front Ports
USB ports: 4 (Hi-Speed)
Front FireWire ports: 1
Front microphone jack: 1
Front headphone jack: 1
Other front ports/controls: N/A
Special Features
Removable motherboard tray? No
Carrying handle? No
Security hook? No
Accessories: Box of various screws
Other stand-out features: N/A
Final Word
Target Market: With its toolless assembly, this is an ideal case for those who frequently add and remove drives.
Pros: Very easy assembly, attractive and clean design, large 120mm intake fan, rear fan that accepts multiple fan sizes, 4 front Hi-Speed USB ports, and FireWire port
Cons: Assembly is nearly toolless, except that you need a screwdriver to unfasten the bay covers. Thumbscrews here could have made assembly entirely toolless.

Koolance PC2-601BW

Some of the watercooling cases we reviewed in this issue came with shoddy packaging, poor instructions, and less than impressive components. On the other hand, the Koolance PC2-601BW came with just about everything we wanted in a prefabricated watercooling system.

Koolance PC2-601BW
$209.99 (base)
www.koolance.com
(253) 839-8999

First Impressions

The company packaged the case with the CPU and GPU coolers right on top, in their own individual boxes, and for good measure, put an instruction booklet in the same spot. We lifted the case out of the box and saw that each component was taped neatly to the interior, keeping them from bouncing around during shipping.

We found quite a range of components inside the case, including our P4/AMD CPU-300-H06 waterblock, CHC-AO5 motherboard cooler, 180-L06 video cooler, and even a hard drive cooler, all of which we purchased from Xoxide (www.xoxide.com). We also saw 1/4-inch clear tubing, a large radiator, and control system secured to the very top of the case; and a pump/reservoir affixed to the case behind the bottom drive cage. The radiator and reservoir came preconnected.

The packages taped to the case contained necessary items such as screws, premixed coolant in a Koolance bag, and more. For all this, we paid $372 with shipping.

The case itself is server-sized, extremely sturdy, and thanks to the steel chassis, quite heavy. It has three external 5.25-inch drive bays, two external 3.5-inch drive bays, and not one, but two removable 3.5-inch drive cages. On top of the case are three fans that help the radiator cool your system's coolant mix; these fans are housed in a plastic compartment with a built-in LCD that displays system statistics.

Installation & Testing

It didn't take us long to get our Koolance system up and running. The CPU waterblock was easy to install, as it uses a system that prevents you from screwing the bolt too tightly.

Once we had each hose connected, it was time to fill the system with coolant. We flipped the case upside down (carefully, as the heavy case repeatedly tried to fall over), unscrewed the reservoir gasket on the bottom side, and used the included funnel to pour coolant into the tank. This process took only a few minutes and there were no visible bubbles in the system when we were finished. When complete, the system was very quiet, though the three fans were definitely audible.

Final Word

If you pay the better part of $400 to obtain a watercooling case, you expect to get your money's worth, and Koolance made us feel like our cash was well spent. We'd recommend this Koolance case to enthusiasts of every stripe because of its excellent construction, high-quality components, and user-friendly setup. CPU

by Nathan Chandler

Basic Specs
Form Factor(s): ATX, other boards up to13 inches wide and 12 inches high
Construction Material: Steel chassis, plastic bezel
Dimensions: 26.25 inches high x 8 inches wide x 18.75 inches deep
Weight: 36 lbs
Power Supply: N/A
Drive Bays & Expansion Slots
5.25-inch (ODD)
Quantity: 5
Description: External
3.5-inch (HDD)
Drive cages: 1 3.5-inch drive cage, 6 total 3.5-inch bays (2 external)
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans
Toolless entry? Yes
Locking panels? Yes
Description of side panel Large window, locking panel with handle
Description of front panel Locking door conceals drive bays
Fans: 3 radiator fans
Vents: 1 rear, 1 front, 1 top
Additional cooling: N/A
Front Ports
Front Hi-Speed USB 2.0 ports: N/A
Front Full-Speed USB ports: N/A
Front FireWire ports: N/A
Front microphone jack: N/A
Front headphone jack: N/A
Other front ports/controls: N/A
Special Features
Removeable motherboard tray? No
Carrying handle? No
Security hook? No
Accessories: Standard case hardware
Final Word
Target Market: Enthusiasts
Pros: Excellent build quality and obvious attention to details at factory
Cons: Very heavy, Koolance sticker on side window

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Custom Chenming 901 Watercooled Case

FrozenCPU offers customized watercooled cases to fit the needs of novice overclockers as well as enthusiasts determined to fry every processor they own. So when we decided to try a case from this site, we went heavy, and selected the Chenming 901 loaded with plenty of extras.

Chenming 901 Watercooled Case
$229 (base)
(780) 463-3838
www.chenming.com

First Impressions

There's no doubt that sheer size is the first thing you will notice about the Chenming 901. It weighs 33 pounds before you start loading it with cooling hardware, and it stands more than 2-full feet tall.

In that hulk you will find room to accommodate a vertically mounted PSU, six external optical drive bays, seven expansion card openings, two external 3.5-inch drive bays, and two fully removable 3.5-inch drive cages. The product description also called for two USB and one FireWire port openings, but ominously, we didn't see these on our case. It wasn't long before we realized that not all was as it seemed with this so-called high-end cooling system.

Installation & Testing

The installation of our kit didn't go smoothly. For starters, we received no instructions to guide us through the process. In addition, nothing came to us preassembled. Neither of these problems were huge drawbacks, as hardcore users might prefer put things together using their own techniques.

However, when we began assembling our components, we realized that we didn't possess the necessary hardware for our project. For instance, we needed screws to secure our 120mm fans to our case and also to secure our radiator to the fans. The only long screws in our kit were included with our CPU waterblock. What's more, though the DangerDen waterblock looked like a nice piece of work, its simplistic, screw-washer-bolt fastening system was tedious and unappealing.

We were upset with the fact that our 120mm fans didn't come with wiring long enough to reach our motherboard. Fan wiring extensions aren't the most common of PC components, and FrozenCPU should have included a note or warning about this problem in the product description because without fans the system is basically useless.

Final Word

We weren't impressed with the hardware we received from FrozenCPU, considering we spent more than $500. In the hands of a veteran overclocker who takes hardware shortages as a challenge, this system would be perfect. On the plus side, FrozenCPU offers dozens of alternate components and accessories to break your piggy bank. If you're interested in convenience, though, you'll have to spend your cash elsewhere. CPU

by Nathan Chandler

Basic Specs:
Form Factor(s): ATX up to 12 inches x 13 inches
Construction Material: Aluminum, plastic
Dimensions: 26.38 inches high x 8 inches wide x 18.5 inches deep
Weight: 33 lbs
Power Supply: N/A
Drive Bays & Expansion Slots:
5.25-inch (ODD)
Quantity: 6
Description: External
3.5-inch (HDD)
Drive cages: 2 drive cages, 2 external bays
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans:
Toolless entry?: Yes
Locking panels?: Yes
Description of side panel: No window, but with locking handle
Description of front panel: Locking front panel conceals drive bays
Fans: 2 120mm radiator fans
Vents: 1 top, 1 rear, 1 front
Additional cooling: N/A
Front Ports:
Front Hi-Speed USB 2.0 ports: N/A
Front Full-Speed USB ports: N/A
Front FireWire ports: N/A
Front microphone jack: N/A
Front headphone jack: N/A
Other front ports/controls: N/A
Special Features:
Removable motherboard tray?: No
Carrying handle?: No
Security hook?: No
Accessories: Standard case hardware
Final Word:
Target Market: Enthusiasts
Pros: Extremely spacious, site offers many different components
Cons: Heavy, necessary hardware missing

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

DangerDen Watercooled Verge

DangerDen Watercooled Verge
$311.95 (base)
http://www.dangerden.com
503.458-6548

DangerDen is renowned for producing snazzy CPU, GPU, and chipset waterblocks. But the company also offers its own line of watercooled cases, so we decided to order one and see for ourselves if the company could live up to its formidable reputation.

First Impressions

DangerDen offered us a lot of alternate components to help us customize our case. We ordered a standard range of parts, such as a Black Ice Xtreme radiator, Hydor L30 pump, Typhoon Quad reservoir, ½-inch tubing, and a single 120mm radiator fan. We selected a Maze4 waterblock, but the company did present a wide variety of other Pentium 4- and AMD-compatible blocks.

DangerDen applied protective static sheets to both the inside and outside of the huge side window, through which we could see a cooling system that was almost entirely preassembled. The reservoir was secured to one of the case's four external 5.25-inch drive bays, and the beefy pump was secured to the case's bottom, right next to the front mounted radiator and fan. Thick, ½-inch tubing connected each of these components.

The case included seven expansion card openings and a standard 3.5-inch removable drive cage. It also had two 80mm fans mounted to the back of the case for even more cooling.

Installation & Testing

Thanks to DangerDen's in-house assembly efforts, we didn't have to dedicate much time to construction. The most time-consuming part of the project involved securing the CPU waterblock, because as with most DangerDen blocks this required us to assemble a handful of screws, nuts, and plastic washers. This wasn't a difficult task, but we prefer systems that utilize existing socket brackets. If you need instructions, the company provides online manuals and video clips.

DangerDen's logical layout meant it took us only a minute to figure out how we wanted our waterflow to work. We turned on our PC and the pump produced a gurgling sound until we managed to bleed out the air bubbles. With the pump quieted, we could hear other noises emanating from the system. The fan was louder than we liked, but with the side panel in place, most users won't notice. Despite the noise, we did like this fan, as it comes with red LEDs that make it appealing in a shadowy room.

Final Word

The well-organized and neatly packaged components really impressed us, and we were very excited with the logically placed preassembled hoses, reservoir, and pump. Enthusiasts who want the maximum in convenience will have very few complaints with this top-quality watercooled case. CPU

by Nathan Chandler

Basic Specs:
Form Factor(s): ATX
Construction Material: Steel chassis, plastic bezel
Dimensions: 22.5 inches high x 10.38 inches wide x 24 inches deep
Weight: 18 lbs
Power Supply: N/A
Drive Bays & Expansion Slots:
5.25-inch (ODD)
Quantity: 3
Description: External
3.5-inch (HDD)
Drive cages: 1 3.5-inch drive cage
Drive adapters: N/A
Expansion slots: 7
Panels, Windows & Fans:
Toolless Entry?: Yes
Locking Panels?: Yes
Description of side panel: Large window, locking panel with handle
Description of front panel: Locking door conceals drive bays
Fans: 1 radiator fan, 2 exhaust fans
Vents: 1 rear, 1 front
Additional cooling: N/A
Front Ports:
Front Hi-Speed USB 2.0 ports: N/A
Front Full-Speed USB ports: 2
Front FireWire ports: 1
Front microphone jack: N/A
Front headphone jack: N/A
Other front ports/controls: N/A
Special Features:
Removable motherboard tray?: No
Carrying handle?: No
Security hook?: No
Accessories: Standard case hardware
Final Word:
Target Market: Enthusiasts
Pros: Superior build quality and almost completely preassembled
Cons: No extra tubing for adjustments, pump installed in a clumsy position

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

Cooltechnica AquaXtreme XG

Cooltechnica AquaXtreme XG
$330 (base)
http://www.cooltechnica.com
(978) 388-7251

Cooltechnica's AquaX-treme XG case lets you use water to cool your PC's overheated components. This is no wimpy starter watercooling system—as you'll see, the XG is a complete cooling product that should let you put the fire out on even the hottest overclocked chips.

First Impressions

Cooltechnica offered us plenty of options for this case, including Swiftech and DangerDen waterblocks for both CPUs and GPUs, as well as a variety of radiators, fans, pumps, and tubing. We selected a Swiftech MCW5002-P waterblock, MCW50 GPU waterblock, Chrome Xtreme LE radiator, ½-inch Clearflex tubing, and the AquaXtreme 50Z-DC12 water pump. We stuck with Socket 478 components, and after tallying up the price of each added part, our grand total was $366.

The case came with several crucial components preinstalled. Cooltechnica kindly connected the reservoir and the pump via a hose and also prepared the bleed-off tube that sprouted from the top of the pump. We accessed the bleed-off tube by removing the second side panel (a matter of removing two more thumbscrews) and pulling the tube away from its spot on the top of the case.

We liked the overall appearance of the brushed aluminum case. The styling was basic but tasteful, which means it will fit in with just about any PC-room theme. The acrylic face on the front of the case looked very nice; however, as with all acrylic cases, we wondered how this one will look after a year of LAN party abuse.

Installation & Testing

Cooltechnica didn't include any instructions to help us put this system together. After some looking on the company site, we did find a shoddy-looking online primer for bleeding off air bubbles, but we didn't locate any other assistance.

Fortunately, we didn't need much in the way of help. We started by installing our motherboard. Sometime during this pro-cess we managed to slash ourselves on a sharp corner inside the case; most edges were quite smooth, but we obviously found a way to cause ourselves harm. (Well, we're just that cool.)

We were happier with the drive bay covers. These popped right out and made it easy for us to install our drives. Unhap-piness struck again, however, when we tried to secure our motherboard to its standoffs. The large, preinstalled reservoir prevented us from adding a screw to the top left side of the mobo, in our opinion one of the more important screws in most systems, especially those with heavy waterblocks hogging the CPU socket. We also weren't pleased with the internal drive bay cage. It was secured by four thumbscrews that were apparently locked with superglue, because we couldn't loosen them without a gargantuan effort.

Final Word

For nearly $400, we expected a bit more glitter and glamour, but the overall aesthetics of this system were underwhelming. Instead, this is an industrial strength kit that will appeal only to hard-core users with more money than time. CPU

Basic Specs:

Form Factor(s): Supports ATX and others up to 12 inches x 13 inches

Construction Material: Aluminum, plastic

Dimensions: 17.2 inches high x 8.6 inches wide x 19 inches deep

Weight: 20.6 lbs

Power Supply: N/A

Drive Bays & Expansion Slots:

5.25-inch (ODD)

Quantity: 4

Description: External

3.5-inch (HDD)

Drive cages: 1 4-bay drive cage

Drive adapters: N/A

Expansion slots: 7

Panels, Windows & Fans:

Toolless entry?: Yes

Locking panels?: No

Description of side panel: Large side window on aluminum panel, thumbscrew-secured.

Description of front panel: 1/3-inch acrylic with brushed aluminum insert

Fans: 1 120mm reservoir fan,1 80mm case fan

Vents: 2 vents, 1 on front bottom, 1 rear center

Additional cooling: N/A

Front Ports:

Front Hi-Speed USB 2.0 ports: 2

Front Full-SpeednUSB ports: N/A

Front FireWire ports: 1

Front microphone jack: Yes

Front headphone jack: Yes

Other front ports/controls: N/A

Special Features:

Removable motherboard tray?: No

Carrying handle?: No

Security hook?: No

Accessories: Standard case hardware

Final Word:

Target Market: Enthusiasts

Pros: Basic but tasteful styling, heavy-duty components

Cons: A few sharp interior edges, overpriced

by Nathan Chandler

CPU Ranking: 0 = Absolutely Worthless 2.5 = Absolutely Average 5 = Absolutely Perfect

A Case Of A Serious Income Gap

An Enclosure For Scrooge & One For Donald

One of the widest ranges of prices you'll find in PC components is in cases. Of course, we've all seen the budget cases for the thrifty computer builder, but just how cheap do cases get? And for that matter, if money were no object, how much money could one spend on a case?

Compiled by Kylee Dickey

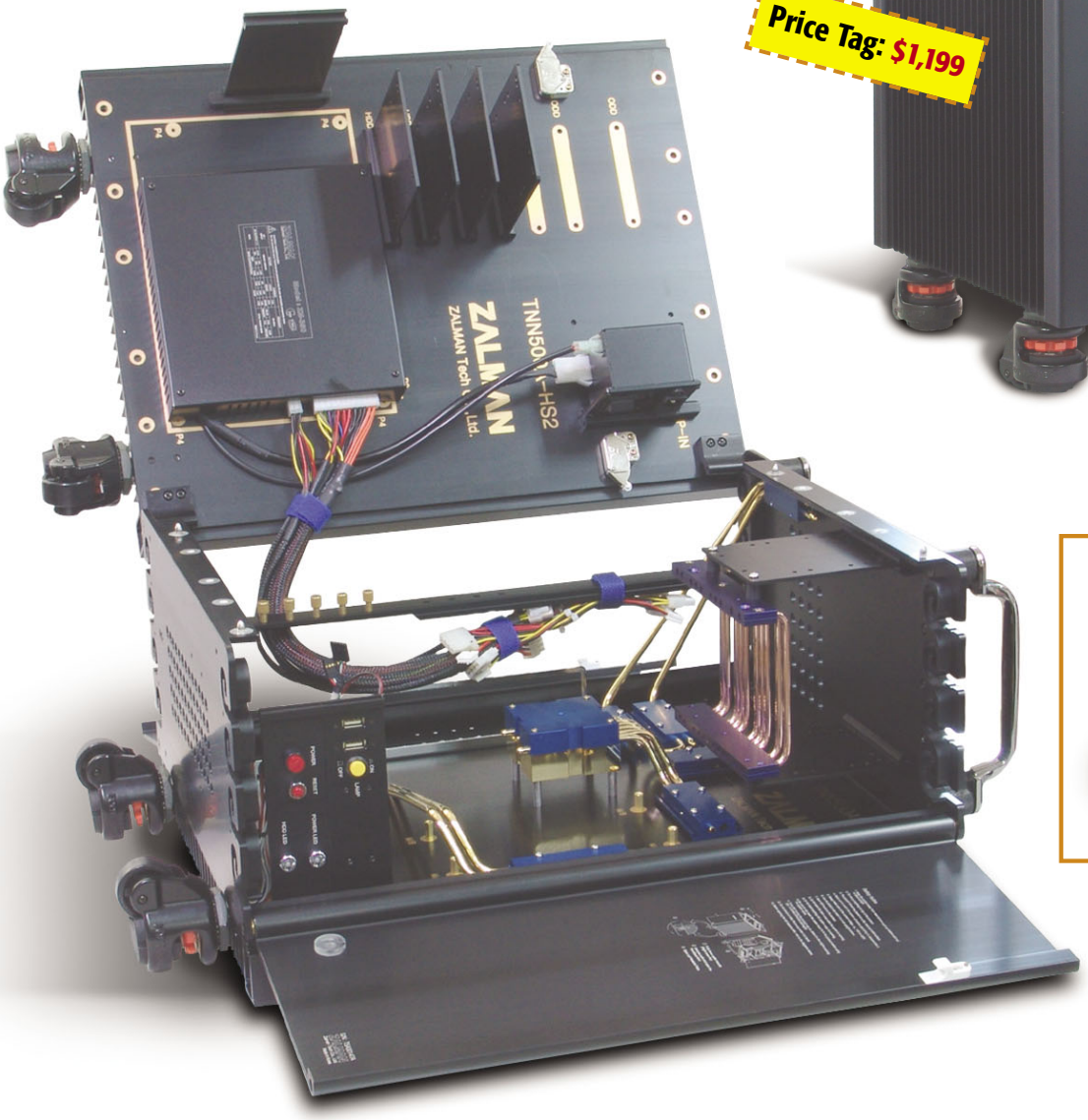
Penny-Pincher Case

The lowest-priced case we found at press time was this beige ATX Mid Tower case, which set us back a paltry $14.99. Among its features are five open ODD bays, one open and two hidden 3.5-inch drive bays, and seven expansion slots. It also has one installed fan and another opening for adding an optional fan. The case is made of steel and has a front door that opens to reveal two Hi-Speed USB 2.0 ports, a FireWire port, and audio ports.

Credit-Card-Crusher Case

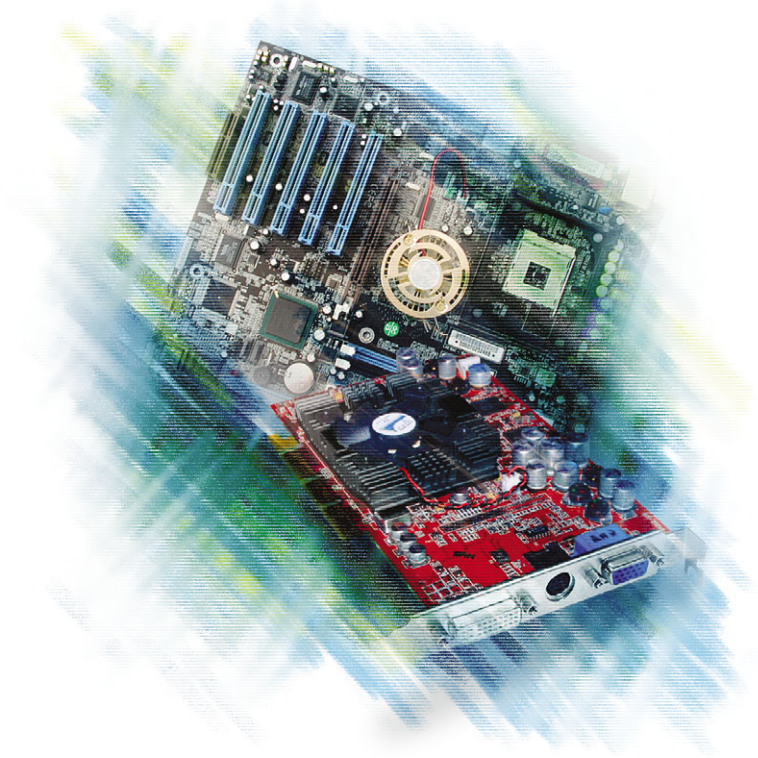
Now that you've seen what $15 will buy, if you have $1,199 handy, you can own your own Zalman TNN 500A, a case with side panels that are actually giant heatsinks. With effective heat management, the TNN 500A operates with a 300W power supply that doesn't require a fan. In addition to absorbing heat, the aluminum side panels also absorb most hard drive noise, resulting in a system noise level below 20dB. An interception block prevents EMI. Heatpipes draw heat from components to the heatsink case. For instance, six heatpipes draw 150Wps from the CPU to the case. Even though the case has no fans, it can effectively cool even a 3.2GHz Intel Pentium 4 processor. The TNN 500A has three ODD bays, six HDD bays, and front USB ports.

Price Tag: $1,199



Integrated vs. AGP

Our Tests Compare Built-In Video With Third-Party Cards



PC enthusiasts tend to treat integrated video with scorn. They pigeonhole this motherboard function as if it were a meaningless afterthought, as a trademark of a motherboard maker out of step with the times. Woe to geeks who have forgotten their roots in integrated video—a concept that's not only still relevant, but also worth considering, especially when you're building a budget-priced system.

That said, everyone knows that integrated video can't really compete with a third-party product. But in benchmarking applications, and in real-world terms, how much better are those fancy graphics cards?

We set out to see just how much difference there is between integrated video and standalone video cards. You already know that the video cards conquered all in our experiments. But what you might not know is that, with certain hardware, the right integrated video chipset will let you play games and run graphics-heavy applications that would choke a low-end video card.

Integrated Video Primer

Compared to third-party graphics cards, integrated video chips receive very little research and development or marketing emphasis from motherboard makers. Manufacturers know users will opt for an AGP graphics card if they want a computer that's suited for gaming or any other graphics-intensive applications. As a result, chips designed to add video capability to motherboards are few and far between, and they receive almost none of the hype that greets the introduction of many graphics cards.

When we began shopping for an integrated video motherboard, we had only a small number of products from which to choose. We selected an AMD-compatible motherboard: the Abit NF7-M. As integrated video goes, this motherboard packs a pretty good punch, sporting NVIDIA's GeForce4 MX AGP graphics, one of the best graphics chipsets available for Socket A.

The NF7-M's integrated graphics chip uses NVIDIA's Lightspeed Memory Architecture, which the company says will improve memory efficiency. It uses 128-bit DDR, a 256-bit graphics engine, and includes advanced graphics capabilities, such as per-pixel shading and texturing.

Of course, the whole idea behind beefing up the integrated graphics chipset is that it helps perform tasks that would otherwise be distributed to the CPU. To that end, the dual 64-bit memory architecture really is one of this chipset's more important traits; it helps a system process up to 6.4GB of data per second, which in our case, should be plenty of horsepower to run a few benchmark applications.

The Testing Setup

Specs and speculation are great, but we wanted to see the cold, hard numbers that showed the performance disparity between integrated video and standalone graphics cards. We set up a basic testing platform so that we could perform a few experiments. This computer included our Abit mobo, 1GB OCZ EL Dual Channel

Integrated Video Scores			
3DMark	**PCMark Suite**	**PCMark Graphics**	**Doom 3**
103*	2891	541	3.5fps
* Only two features tests possible in 3DMark			

Series Gold Edition DDR PC-4400, and an ASUS DVD-ROM drive. To round out the system, we chose the most powerful CPU compatible with this board, the Athlon XP 3000+ with 333MHz FSB.

Then we added a twist to our tests by building a second system. In this one, we installed a budget-priced motherboard, inexpensive CPU, and super-affordable video card.

After we set up these systems, we ran our benchmark applications to create a few baseline numbers. For initial testing, we ran the system suite and graphics routines in PCMark 2004. We switched to 3DMark 03 to get a better handle on each system's graphics capabilities, and then rounded out our experiments with real-world tests—the demo mode in Doom 3.

Establishing a few performance statistics was just the beginning. After we obtained those numbers, we began swapping out the second system's processor with increasingly faster chips, trying to find the point at which this PC's graphics performance exceeded that of our integrated video machine.

Then we repeated the experiment, only this time we stuck with the same CPU and installed a series of progressively more powerful video cards. The idea here, of course, was to determine how much of a difference a graphics card can make when installed with a slow or mid-range CPU. In the end, we found a number of interesting points regarding the differences between integrated video and standalone graphics cards.

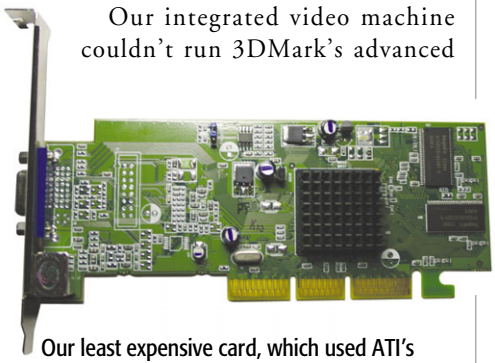
NVIDIA Strikes

We started by letting our integrated video system set the pace for all of our tests. As expected, we weren't exactly wowed by this system's performance, even though it came equipped with the fastest compatible processor.

The PCMark score, however, was solid. After we ran the system suite routine, we saw a final score of 2891, which, as you'll see, was much higher than with many of the other setups we used during the course of testing. The individual graphics score (541) wasn't as impressive.

The time for more rigorous testing came when we loaded 3DMark and Doom 3. And for all of you rooting for the integrated video chipset scores, now is the time to cover your eyes.

Our integrated video machine couldn't run 3DMark's advanced graphics routines. So instead of completing a full load of 3DMark routines, we had to settle for only two of the program's feature tests. Our final score was 103.



Our least expensive card, which used ATI's Radeon 7000 hardware, failed to top our integrated video chipset scores.

Things didn't get any better when we ran the Doom 3 demo. We configured the program to run at high quality, with a resolution of 1,024 x 768. Then we launched the demo and waited . . . and waited, and waited. We ended up with a 3.5fps rating, which was far too slow for gameplay.

Keep in mind that the minimum system requirements for Doom 3 are pretty intense. ID Software recommends a system that uses the equivalent of a 1.5GHz Pentium 4, 384MB of RAM, and most important for this story, a graphics card with at least 64MB of memory. Basically, our built-in video chip was the bare minimum we could use to make the game demo run.

These scores set the stage for a showdown with our second system, which was armed with a stack of CPUs and video cards. We didn't expect much of a battle, and on that count, we were right, but our integrated video scores held up better than you might anticipate.

Card Contenders

We'll start by showing you the results we saw after we swapped video cards in and out of our second computer. For this series of tests, we stuck with our Athlon XP 2000+ to see how this relatively slow processor's scores would change as we installed various graphics cards.

But first, we'll introduce the video cards that we used for our tests. We selected a broad range of cards with widely varying memory levels and, just as important, very different prices. Some of these cards are obviously outdated or completely irrelevant for hardcore gamers; other cards have high octane specifications that make gamers and graphics lovers drool.

Our first graphics card, the Sapphire ATI Radeon 7000, cost less than $40. This 64-bit card came with 64MB of onboard DDR memory and a core speed of 166MHz, and unlike newer cards, it only has AGP 4X capability instead of AGP 8X.

Our second card was Rosewill's NVIDIA GeForce MX4000, a 32-bit card with 64MB of memory. This card's core speed is 275MHz, and like the Sapphire card, this one had a price tag of less than $40.

This Gainward card was the first to complete each of the rigorous benchmarking tests we ran. It also obliterated the scores from our integrated video system.

The third card in our tests was Sapphire's $140 ATI Radeon 9600XT, with a core speed of 500MHz and 128MB of memory.

We also used Chaintech's NVIDIA GeForce FX5900XT. This card was one of the more expensive models in our lineup, costing nearly $170. It's equipped with 128MB of memory and had a core speed of 390MHz. To round out our testing, we also tried out the 128-bit 256MB Gainward GeForce FX5700LE ($120) and 64-bit 128MB Sapphire ATI Radeon 9600SE cards ($45).

As you can see, we managed to work with cards equipped with very different hardware. Those disparities were obvious once our testing was complete.

Play your cards. We paired each video card with our AMD processor and executed our benchmarking schemes to completion whenever possible. Several cards refused to run properly when faced with the challenging requirements of 3DMark and Doom 3, but we didn't have as many problems with the more gentle tests from PCMark.

Our PCMark scores weren't very impressive during this first series of tests. In fact, in this category, our integrated video machine throttled the XP 2000+ no matter which video card we used. The highest PCMark score we saw with this CPU was 2764, and the system bottomed out at a whole 1000 points lower when we used our least expensive video card.

When we launched 3DMark, our chart numbers changed in a hurry, though not with our lower-end video cards. Our Sapphire ATI 7000 was capable of running only a couple of the feature tests, part of the reason it logged a score of only 49. Even when we ran PCMark's easier tests, this card's final graphics score was only 363. When we tried to run Doom 3, the program displayed an error message, as the card's hardware simply couldn't handle the game's overload of data.

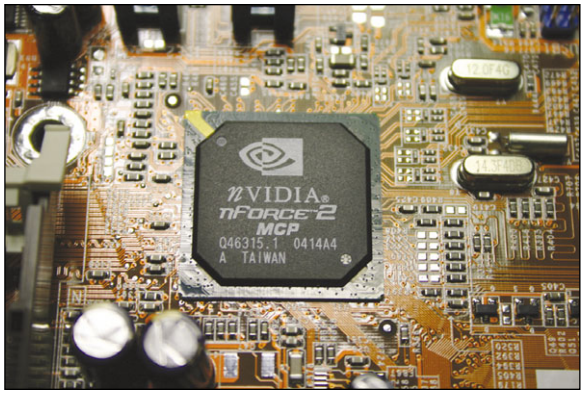
So, the least expensive card couldn't usurp our integrated video scores. However, it didn't take long for a real challenger to emerge, in the form of the Rosewill NVIDIA GeForce MX4000. This product helped our test system churn out a PCMark suite score of 2613, only about 300 points lower than with our supposedly faster integrated video machine.

Then the real hitting started. The Rosewill, though incapable of running every 3DMark test, scored 173 points, beating our integrated video score by 70 points. More tellingly, this card almost tripled our integrated video's score of 541, and it doubled the FPS rating in our Doom 3 demo.

From that point on, no matter which card we used or which benchmark program we used to create scores, our integrated video system took a serious pounding. The Sapphire ATI Radeon 9600SE was the first budget-priced AGP card to run most of our tests without errors, and even though this card generated a PCMark suite number lower than that of our integrated video system, it scored 1565 points in 3DMark, and also had a 10.9fps rating in Doom 3.

The Gainward GeForce FX5700LE was the first card to complete every test we sent its way. This particular configuration had a PCMark suite score that was lower than that of our integrated video system; however, its graphics scores were much, much better.

These experiments demonstrated how ineffective integrated video is compared to even the modest power of an inexpensive third-party graphics card. However, we weren't ready to give up on our integrated video chipset just yet.



This NVIDIA chipset helps run the onboard graphics. It's perfect for users who don't consider heavy-duty gaming a priority.

The Great CPU Swap

We decided to take a new angle for our second round of testing. Instead of swapping video cards, we left our budget cards installed and used a variety of CPUs to see how this equipment change would alter our benchmark scores.

Even though our Sapphire ATI 7000 card had trouble running our entire slate of tests during the first benchmarking session, we decided to find out if a faster CPU would improve this product's performance. We used three more CPUs, including AMD's Athlon XP 2400+, XP 2700+, and XP 3000+. And as you can probably guess, we had very little success in creating better benchmark numbers.

A simple CPU swap wasn't enough to overcome this card's hardware shortcomings. No matter which CPU we used, we couldn't run more than a couple of tests in 3DMark, which was why this score didn't budge at all. We never could get the Doom 3 demo to load, either.

Slow CPU, Faster Performance

We tested each of the following graphics cards with an AMD Athlon XP 2000+ CPU. These numbers show how swapping graphics cards can make a huge difference in overall system performance.

Card	3DMark	PCMark Suite	PCMark Graphics	Doom 3
Sapphire ATI Radeon 7000	49*	1787	363	No boot
Rosewill NVIDIA GeForce MX4000	173*	2613	1287	6.6fps
Sapphire ATI Radeon 9600SE	1565	2596	1025	10.9fps
Sapphire ATI Radeon 9200SE	1587	2607	1099	Errored out
Gainward NVIDIA GeForce FX5700LE	1949	2645	1895	9.3fps
Sapphire ATI Radeon 9600XT	3421	2764	2410	19.5fps
Chaintech NVIDIA GeForce FX5900XT	4002	2706	3518	14.4fps

* Only two features tests possible in 3DMark

Our PCMark scores were still interesting, though, in part because they varied so little from CPU to CPU. PCMark suite scores improved steadily each time we installed a faster CPU, but the increases were marginal. Our XP 2400+ score was 2595, and switching to the XP 3000+ provided an improvement of only about 200 points. Furthermore, the PCMark graphics score remained almost exactly the same through our tests, and in some cases, were actually lower than when we used our XP 2000+ CPU. In a last-ditch attempt to juice up this card's performance, we installed an XP 3200+, but again, this fast CPU made virtually no difference in the 7000's scores.

Our Chaintech video card blew away most of the benchmark scores in our tests, making our integrated video system look puny in comparison.

Because faster CPUs alone couldn't help our low-end graphics cards, we shifted the focus of our tests to the first card that zipped through all of our tests without problems. That meant reinstalling the Gainward card. With this card matched to our variety of processors, our test machine flattened all of the scores from our integrated system.

Once our integrated video was down for the count, we figured it couldn't hurt to salt its wounds a little. We ended our CPU swapping session by paring our XP 3000+ with the Chaintech FX5900XT to see just how high our test system's scores could go. Our system displayed a final PCMark suite score of 3412, about 600 points better than the best number from the integrated video system. The PCMark graphics score was 3714, and the 3DMark score was 4288; both numbers, of course, were far higher than any integrated video could hope to fly. We found the Doom 3 numbers interesting, however, because even with a much more expensive CPU, our system ran the demo at only 1fps faster than with the XP 2000+.

Hardware Realities

If you have a limited technology budget, you will undoubtedly take heart from our test results. We proved that it's not always necessary to spend a lot of money to get adequate video performance from a PC.

For example, in some cases switching to a more expensive CPU had a negligible affect on our system's performance. In other situations, using a slower CPU but upgrading to a better video card pushed our benchmark scores significantly higher. So depending on your needs, you might be able to perform an inexpensive upgrade to prolong the life of an aging system.

We were disappointed (but not surprised) that our integrated video system didn't provide the kind of performance needed for decent graphics performance. Using a typical integrated video chipset, you won't have any real problems running office applications, and you should be able to play basic games at low or medium quality. But you can safely assume that integrated video will make it impossible to have fun toying around in any advanced first-person shooters.

If you like gaming and you're considering a motherboard with integrated video for your home machine, you might want to think again. Keep in mind that an integrated video chip adds to the cost of such motherboards, and even if this capability bumps the board's price by only $10 to $20, that's still a significant chunk of change; you could invest those dollars in a low-end video card that will drastically improve your graphics performance. The good news is that even if your system already has integrated video, it's almost certainly equipped with an AGP slot, meaning that graphics glory is simple matter of opening your case and installing a new third-party card. **CPU**

by Nathan Chandler

There's More To Life Than CPUs

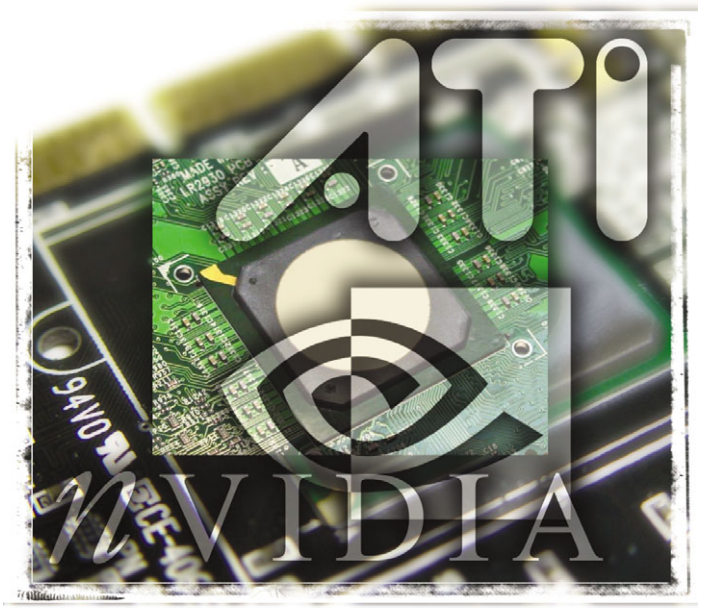
Here are the benchmark scores we saw after using three alternate CPUs with four of our video cards. Sometimes a faster CPU gave our scores a nice jolt; other times our more expensive CPUs had a negligible impact.

	CPU	3D`Mark	PCMark Suite	PCMark Graphics	Doom 3
Sapphire ATI Radeon 7000	XP 2400	63*	2595	321	No boot
	XP 2700	65*	2779	326	No boot
	XP 3000	66*	2820	327	No boot
Rosewill NVIDIA GeForce MX4000	XP 2400	177*	2937	1295	6.6fps
	XP 2700	192*	3188	1327	7.0fps
	XP 3000	192*	3286	1346	7.1fps
Chaintech NVIDIA GeForce FX5900XT	XP 2400	4082	3071	3570	14.6fps
	XP 2700	4249	3310	3676	15.0fps
	XP 3000	4288	3412	3714	15.1fps
Gainward NVIDIA GeForce FX5700LE	XP 2400	1957	2970	1948	6.7fps
	XP 2700	1992	3224	1998	6.7fps
	XP 3000	1999	3290	2013	6.7fps

* Only two features tests possible in 3DMark

The Great GPU Wars

Graphics Giants Square Off Again



It's been an exhilarating year for ATI and NVIDIA. With games like Far Cry and Doom 3 flying off the shelves, we've seen the top two GPU makers roll out chips that can (almost) take full advantage of the new game engines at even the highest quality settings. You've seen the benchmarks. You know that with Half-Life 2 set to appear any day now, (really, we're serious) the brawl between ATI and NVIDIA can only heat up.

"You have seen a huge upswing in what were termed next generation games. We're excited about it. The engines look good; the games that are based on those engines look good. There [are] a lot of high profile games on the horizon that are going to require some graphics horsepower. [The new graphics engines] are going to be more taxing for graphics cards, and that's a good thing for graphics companies," says Brian Del Rizzo, NVIDIA's Platform Products Manager.

Games aren't the only concern on ATI and NVIDIA's minds. After the much ballyhooed announcement of PCI Express, we're finally starting to see the promises come to fruition. Intel's Grantsdale and Alderwood chipsets are the first to support PCI-E, and new LGA775 (Socket T) boards have rolled off the assembly lines sporting PCI-E x16 slots for PCI-E graphics cards.

As a result, the each GPU giant has been scurrying to one-up the other in an effort to claim market dominance. With the ATI's X600 and X700 series set to square off against NVIDIA's GeForce 6600 GPUs, the battle for dominance in native PCI-E chips looks as though it will be as hotly contested as was the AGP battle.

Even though it looks as if the AGP slot may be taking a back seat (it's been

ATI vs. NVIDIA

It's difficult to be precise when comparing GPUs from the two heavy hitters, ATI and NVIDIA. While attempting to correlate one particular ATI chip with an identical NVIDIA counterpart falls somewhere between the difficult and the impossible, we did our best to show you the rough equivalent of each. Rating performance is also a slippery slope, so chips built on the same architecture have been split up. Also, expect some performance overlap; for example, ATI's newest Radeon X700 XT GPU will probably be a better performer than the Radeon 9800SE. GPUs that are only available on PCI Express cards are noted. Some GPUs are available on both AGP and PCI-E cards.

ATI Chip	NVIDIA Chip
Radeon 9200 SE	
Radeon 9200	GeForce FX 5200
Radeon 9200 PRO	GeForce FX 5200Ultra
Radeon X300 SE (PCI Express)	
Radeon X300 (PCI Express)	GeForce PCX 5300 (PCI Express)
	GeForce FX 5500
	GeForce FX 5600 Ultra
Radeon 9600 SE	
Radeon 9600 LE	GeForce FX 5700 LE
Radeon 9600	GeForce FX 5700
Radeon 9600 PRO	
Radeon 9600 XT	GeForce FX 5700 Ultra
	GeForce PCX 5750 (PCI Express)
Radeon X600 PRO (PCI Express)	
Radeon X600 XT (PCI Express)	
Radeon 9700	GeForce FX 5900
Radeon 9700 PRO	GeForce FX 5900 XT
	GeForce FX 5900 Ultra
Radeon X700 (PCI Express)	
Radeon X700 PRO (PCI Express)	GeForce 6600 (PCI Express)
Radeon X700 XT (PCI Express)	GeForce 6600 GT (PCI Express)
Radeon 9800 SE	
Radeon 9800	GeForce FX 5950
Radeon 9800 PRO	GeForce FX 5950
Radeon 9800 XT	GeForce FX 5950 Ultra
Radeon X800 PRO	GeForce 6800
Radeon X800 XT	GeForce 6800 GT
Radeon X800 XT Platinum Edition	GeForce 6800Ultra

axed completely from many new LGA775 boards) to PCI-E, both companies' best chips (ATI's Radeon X800 XT Platinum Edition and the NVIDIA GeForce 6800 Ultra) are available on AGP cards. Del Rizzo says he still expects AGP cards to hang around as long as there is sustained demand.

"With native PCI Express chips, we can take our High Speed Interconnect chip to take [native PCI Express chips] back to AGP. Our partners can provide AGP cards as long as the demand is there," says Del Rizzo.

Both companies have also done an admirable job of designing new chips for enthusiasts of all budgets. If you're ready to upgrade your old graphics jalopy or you're just curious to see how your card stacks up, check out the reference chart. It lists the NVIDIA chips and their ATI counterparts. The chip families are grouped together and ranked by performance, although some overlap will occur, as high-end versions of an older family typically outperform budget versions of a newer family. For example the ATI Radeon 9600 XT is a better GPU than the newer Radeon 9800 SE.

The NVIDIA GeForce 6 series cards represent a new breed of video card: PCI Express, a newer technology that allows roughly twice the bandwidth of the older 8x AGP graphics bus.

Just in time for the holidays, we've also included a few quick buying tips for video cards. Finally, our "GPU Roadmap" sidebar takes a peek into ATI's and NVIDIA's respective crystal balls to see what's on the horizon for each company. CPU

by Vince Cogley

GPU Roadmap

With the introduction of NVIDIA's GeForce 6 series GPUs and ATI's Radeon X series cards, it appears that the dust has settled for the time being. Although both companies were tight-lipped about their future plans, NVIDIA's Brian Del Rizzo said it's relatively easy to guess when a new particular chip would be released.

"We take an architecture, push it top to bottom, and proliferate our product line with chips from a $79 price point up to a $599 price point. We differentiate those chips through performance levels. Every year or year and half, we bring out a different architecture and do the same thing," he said. ▲

Video Card Buying Tips

Your current graphics card is overclocked to the hilt, and you still can't push past the single digits in fps on Doom 3. Goodbyes are painful, but maybe it's finally time you put your old card in the circular file and started hunting for a shiny new replacement. Following these tips can help you find the card that fits your needs.

Do your homework. Not only is a few hundred dollars a lot to spend, it's a lot to spend on a graphics card that might only offer you marginal performance gains. Spend some time perusing hardware forums discussing the best video cards. A simple Google search of the card you're interested in will likely turn up a number of product reviews. And because we're never above a shameless plug, we'll note that the pages of *Computer Power User* are teeming with reviews of the latest graphics cards from a number of different manufacturers.

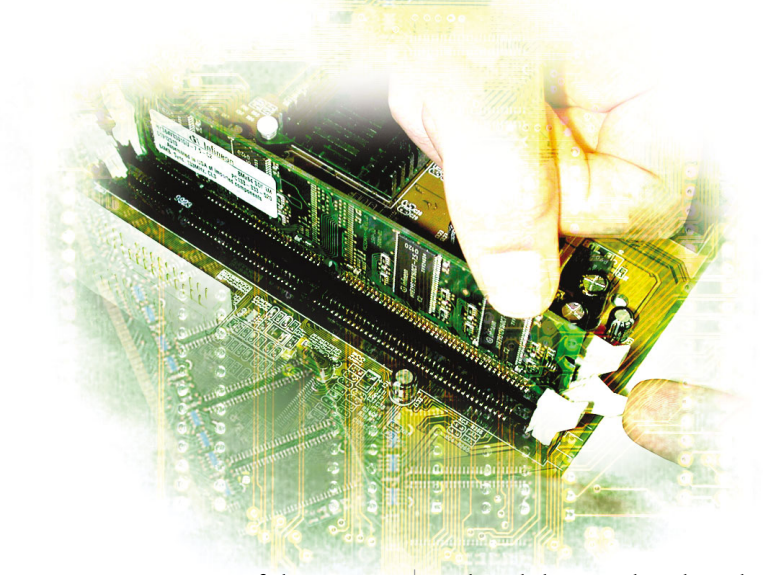
Go online. Big box electronics retailers like Best Buy and Circuit City simply don't have the shelf space for every single new graphics card, not to mention older ones. There are plenty of online retailers that have a broad selection of cards at comparable prices. Pricegrabber.com is a good place to start, but you may have to visit each retailer's Web site to find your diamond in the rough.

Newer doesn't necessarily mean better. As we mentioned earlier, both ATI and NVIDIA have done a great job of introducing new chips for both the entry-level buyer looking for a solid card at a reasonable price and the power user willing to sacrifice a kidney for the best card on the market. As a result, don't discount a graphics card just because it's been around the block a few times; an ATI Radeon 9800 XT should outperform the Radeon X300 SE any day of the week. Many times, you'll be able to find an excellent older graphics card at a discounted price.

Look beyond the RAM. Many first time buyers fall into the trap of buying a graphics card based solely on the amount of memory it has. Indeed, this is one of the most important features of a graphics card, but it's not the *only* feature. The GPU plays a huge role in a card's performance, which helps explain why a graphics card with a newer GPU and 128MB of RAM often outclasses a card with an older chip and 256MB of RAM. Core speed and memory speed are two critical areas, too. Finally, ATI cards have historically beaten NVIDIA in Direct X-based applications, while NVIDIA has bested ATI in Open GL-based games. ▲

No Need To RAM Your Head Against A Wall

Choose The Right Memory For Your System



Memory is one of the components of a PC that requires the most thought before making a purchase. There are many types of memory available, and choosing the right frequency, number of modules, amount of RAM, and latency can make a tremendous difference in the performance of your system. Furthermore, there is a full stock of discount memory available, which is fine for many systems, but if you plan to overclock, it is probably wiser to stick with brands of memory that have a reputation for being forgiving when users tweak system settings.

Memory Type

First you need to choose the proper type of memory. Your motherboard's or computer's users manual should indicate what type of memory your system takes, as should the manufacturer's Web site. Most memory manufacturers also provide online tools to help you select the right memory for your motherboard. Most systems use DDR SDRAM, which is timed with the system clock and which transfers data on both the rising and falling side of each clock cycle. Therefore, a DDR SDRAM module with a 300MHz frequency can operate at up to 600MHz if the system bus supports such transfer rates.

Some newer systems, such as motherboards built on Intel's 915 chipset, use DDR2, the most recent JEDEC-approved (the Joint Electron Device Engineering Council) memory standard. DDR2 holds the potential to offer several improvements to systems. One of the most significant advantages to DDR2 is its 4-bit data prefetch. This lets DDR2 read and write four sets of data at a time, an improvement over the 2-bit data prefetch of DDR. DDR2 also requires less power than DDR, leading to less heat and improved stability. Most motherboards only accept one type or the other because DDR has 184 pins, and DDR2 has 240 pins. Some motherboards do have both types of slots, but you can still use only one type of memory at a time. The dual support merely adds an upgrade path for those who want to switch to DDR2 later. DDR2 also comes in an FBGA package with a ball-grid array, making it sturdier and less space-consuming than DDR.

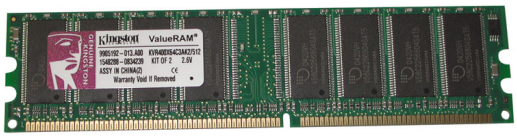
Registered, unbuffered, and ECC. Memory also comes in either registered or unbuffered modules. Registered memory provides greater reliability and system stability, but it is more expensive. Usually registered memory is reserved for servers, whereas most home PCs use unbuffered memory. However, 64-bit AMD processors are an exception to this rule, since the Opteron and Athlon64 FX require the more expensive registered memory. Your motherboard will only take one type or the other, so check the documentation to see which you need.

Not all motherboards support ECC memory. There is a benefit to using this type of RAM, which checks for data transmission errors, improving the accuracy of system operations. However, most users buy non-ECC memory because they do not need the level of accuracy that ECC provides to critical operating environments and servers.

The Need For Speed

Speed is one of the most important considerations for many users. Speed is expressed in terms of the memory's frequency in megahertz, or millions of cycles per second. For example, a 400MHz memory module sends data at a rate of 400 million cycles per second, but because it operates on both the rising and falling side of each cycle, can actually transfer data at a rate of 800MHz, provided that the motherboard's system bus supports such a high transfer rate.

The fastest memory supported by JEDEC, the organization that oversees memory standards, is PC3200, also known as DDR400 (400MHz). Although you can get faster DDR, such as PC4400 (DDR550), it is not JEDEC-approved. After approving PC3200, JEDEC began



This is a standard 184-pin DDR SDRAM memory module. As you can see, it has no heat spreader or other features and is part of Kingston's ValueRAM line.

Some of GeIL's DDR modules, such as this one, include a sticker that provides an approximate temperature reading.

This memory, which features a black heat spreader, is one of Mushkin's first DDR2 memory modules.

The module above is GeIL's new 512MB PC2-5300 DDR2 with CL 4-4-4-12 latency.

standardizing DDR2 instead of DDR. You can buy faster memory than what your motherboard supports, but remember that without overclocking your system, the memory will only perform at the level of the highest memory rated for your board. For example, if a motherboard supports a 200MHz system bus, the fastest DDR supported by the board would be DDR400 (PC3200) because the double-data rate would let the memory run at two times the rate of the 200MHz system bus, or the memory's full 400MHz frequency. In comparison, to run PC3700 on the same board at its full 466MHz frequency, you would need to overclock the system so that it ran with a 233MHz system bus.

How Much Is Enough?

There is no direct answer to how much memory you should install in your system. However, you shouldn't buy more memory than your system supports. There are two factors that determine how much memory you can install. First, check the amount supported by your OS. Each OS supports a different amount of memory. For example, Windows 9x tops out at 1GB, while Windows XP supports up to 4GB of RAM.

It is also important to know how much memory your motherboard supports. If the board only supports 1GB of RAM, you will derive no benefit by installing 2GB of memory. In fact, you may actually see a decline in performance as the system tries to reconcile the amount of memory installed with the amount it is equipped to handle.

Once you know the limits of your OS and motherboard, you can assess the types of applications you run on your PC to get a good feel for how much RAM will meet your needs. If the only applications you run are basic word processors and an email client, you can probably get by with the minimum requirements for your OS.

However, many users—especially those using memory-intensive programs, such as games, graphics-editing software, and video-editing applications—can benefit from additional memory. In addition, memory can improve system performance for those who multitask. Most home users will find that 256 to 512MB will suffice. Many serious computer builders and tweakers prefer at least 1GB of RAM, and if you run graphics-heavy application, such as games that incorporate 3D graphics, having at least 2GB of RAM will improve performance.

Do The Math

The next decision you'll need to make is whether you should add two modules or one to achieve the desired amount of RAM. For example, if you want to install 1GB of RAM, you can install one 1GB module or two 512MB modules.

One advantage to installing two modules is that if one fails, you still have memory and a functioning system. If you install only one module and it fails, you can't run Windows until you install more memory.

There are speed issues to consider, though. If your motherboard does not support dual-channel memory, your system will probably perform more efficiently with just one module installed, as there will only be one module adding a latency factor to the system. However, if your system supports dual-channel memory, you should install two modules for the maximum performance. Intel-based systems in particular see dramatic improvements when two modules are installed to take advantage of dual-channel technology. Most AMD systems see little or no improvement by using dual-channel mode. The exception is AMD's 64-bit systems, which do benefit from dual-channel configurations.

Latency Considerations

Finally, if you plan to play games or run graphics-intensive applications, you should look for memory with a low latency or CAS timing. This indicates how much of a lag there is between when a data request is issued and when the data is available in memory. Latency is expressed in terms of how many clock cycles it takes to address the data request. Therefore, a system with CL2.5 memory will take only 2.5 cycles to address data and be somewhat faster than a system with CL3 memory.

Overclockers will benefit from low-latency RAM because its faster access to data will help you achieve better overclocks. However, lower-latency RAM costs more than higher-latency memory, so if you don't use graphics-intensive applications or overclock, you won't notice much of a performance boost with low-latency memory.

This Article's Just A Memory Now

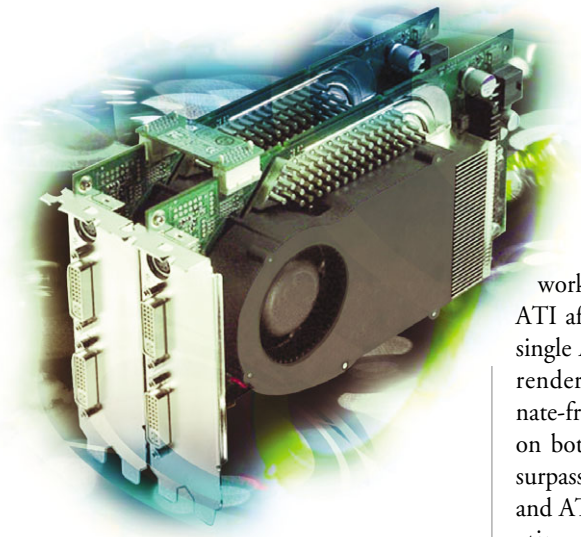
The important thing when shopping for RAM is to keep in mind your system specs as well as the type of applications you use on your PC. Armed with your knowledge of memory and a basic understanding of the type of system you want, you'll be amazed what a difference the right memory can make. CPU

by Kylee Dickey

Tech White Paper:

NVIDIA's SLI Technology

Two Video Cards Are Better Than One



Graphics card manufacturers will go to almost any length to improve performance, so long as it's somewhat economical and technologically feasible. The most significant leaps occur roughly once a year, when graphics giants ATI and NVIDIA unveil their new architectures and impress enthusiasts with cruelly priced flagship products. It hasn't always been this way. Once upon a time, 3D was still an emerging concept. The cards didn't cost as much and there was still plenty of competition.

In 1998, 3dfx started shipping its Voodoo2, a 3D-only accelerator that effortlessly beat the pants off of every other card on the market. Its hallmark feature was support for SLI (scan line interleaving), a technology that allowed two Voodoo2 PCI cards to render 3D environments cooperatively by dividing them into odd and even scan lines, horizontal rows of pixels generated by a monitor's electron gun. One card rendered the odd lines and the other operated on even lines, yielding a dramatic performance boost.

However, adoption of the AGP bus ended the reign of 3dfx and its SLI technology. David Nalasco, technology marketing manager at ATI, claims that AGP was never meant to accommodate two graphics cards. And although possible, designing a motherboard with support for two cards would have required deviating from the AGP specs and some fancy footwork to route relevant signals.

Not that there weren't attempts to work around AGP's limited flexibility: ATI affixed two Rage 128 Pro chips to a single AGP card back in 1999 and used a rendering technique called AFR (alternate-frame rendering) to balance the load on both processors. But it wasn't able to surpass NVIDIA's superior GeForce 256, and ATI never wrote drivers for any operating system other than Windows 98. Consequently, the Rage Fury MAXX existed for only a short time.

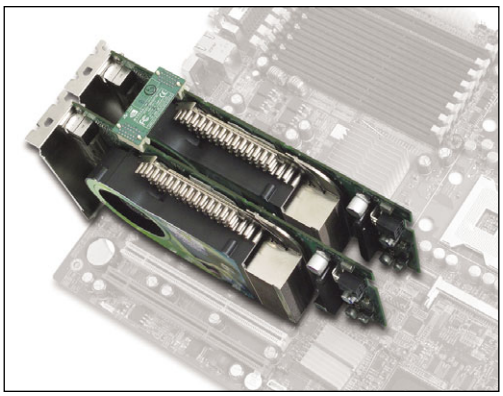
Nowadays, 3D processors are so complex that it probably wouldn't make much sense to design a super-high-end card with multiple chips. "Such a product would surely enhance 3D, but simultaneously introduce multiple 2D blocks, video engines, and memory subsystems, duplicating a lot of unnecessary components that add to cost," says Nalasco. "Those designs generally make most sense for specialty applications, such as the Evans and Sutherland simFUSION military simulators that already use multiple R300 processors." 3DLabs, another prolific player in workstation graphics, recently announced its Wildcat Realizm 800, a dual-processor PCI Express card that sells for $2,800.

NVIDIA Breathes New Life Into SLI

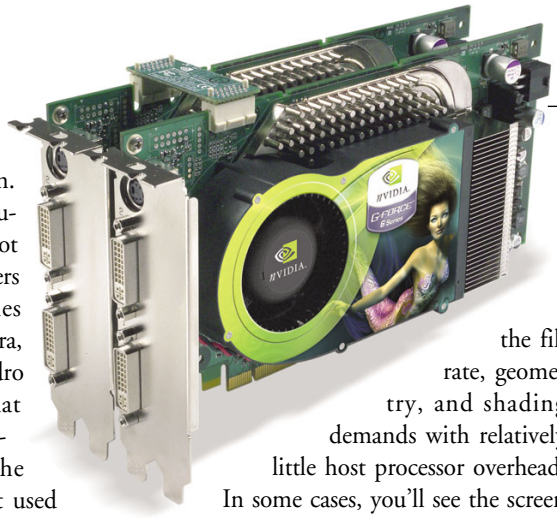
If spending four digits' worth of income simply isn't an option and you're still craving breakneck frame rates, NVIDIA's rebranded SLI (now trademarked by NVIDIA and standing for Scalable Link Interface) might be your medicine. Although the underlying technology differs from 3dfx's implementation of old, both harness the power of two graphics cards running in tandem to augment 3D performance. 3dfx was able to work its magic over the PCI bus and NVIDIA is leveraging the power of PCI-E to enable its technology.

Because PCI-E utilizes a point-to-point topology, manufacturers don't have to worry about complicated routing or the throughput issues of a shared bus. Each x16 link delivers 4Gbps of dedicated, bi-directional bandwidth, perfect for what NVIDIA's trying to accomplish with SLI. Of course, most desktop motherboards that currently support PCI-E graphics cards only work with one. In order for SLI to even be an option, you need a more advanced platform designed for multiple high-speed PCI-E devices.

For the time being, Intel's E7525 workstation chipset is really the only viable option for enabling SLI. It features a total of 24 PCI-E lanes broken up into x16 and x8 links. Although that isn't sufficient to completely support two x16 PCI-E graphics cards, the interface is designed in such a way as to facilitate lane negotiation, allowing an x16 card in an x16 slot electrically wired to run at x8. Remember, one x8 slot still offers 2Gbps of bandwidth and that's enough to plow through today's most demanding games.



Two GeForce 6800 Ultra cards on an E7525 motherboard will consume plenty of power and generate gobs of heat.



A pair of GeForce 6800 Ultra cards occupies four slots, limiting expandability somewhat.

The Hardware

Owning a motherboard with two PCI-E x16 slots only fulfills half of the SLI equation. Those slots also need to be populated with compliant cards. Not surprisingly, only select members of NVIDIA's GeForce 6 series qualify, including the 6800 Ultra, 6800 GT, 6600 GT, and Quadro FX 3400. NVIDIA claims that each model features special circuitry devoted to enabling the MIO (multipurpose I/O) port used to connect its cards in an SLI configuration. Keep in mind that both boards must be the same model and from the same vendor to ensure compatibility.

A small link card physically connects the matching video cards, making it possible for them to communicate using NVIDIA's proprietary inter-GPU protocol. On a system with one x16 slot and one x8, the card with more bandwidth is designated the primary adapter, while the other assumes secondary duties. The primary device is the only one that produces a video output, so in SLI mode, the cards will only support one display, according to NVIDIA's senior PR manager, Brian Burke. If you remove the link card and disable SLI, the two cards support a cumulative total of four display outputs at the expense of 3D performance.

The Software

Despite its namesake, the new SLI doesn't divide its workload evenly between two video cards drawing odd and even scan lines. NVIDIA claims that its solution is more elegant than 3dfx's old technique. The graphics driver is effectively able to analyze 3D scenes and divide the load sent to each video card according to the fill rate, geometry, and shading demands with relatively little host processor overhead. In some cases, you'll see the screen divided horizontally into halves, but because the whole process is dynamic, workloads constantly shift to reflect varying loads placed on each card. Thus, although one frame might be cut 50/50, if the next is imbalanced, NVIDIA's driver will make adjustments to compensate.

If the split-frame technique described above doesn't yield ideal results, it can switch to alternate-frame rendering, the same technique utilized by ATI's decrepit Rage Fury MAXX.

SLI is completely implemented in NVIDIA's hardware and software, rendering the technology transparent to affected applications, such as games. Load-balancing and other adjustments should have no effect on image quality and performance will only increase. In fact, running Futuremark's 3DMark03 at 1,600 x 1,200 with 4x antialiasing and 8x anisotropic filtering, NVIDIA claims a 187% boost using SLI. Unfortunately, there still aren't any third-party benchmark results to substantiate that claim. And of course, it's important to remember that SLI will have the most potent impact on high-end machines with 3.6GHz processors and plenty of memory. Slower machines don't bog down in Doom 3 because one GeForce 6800 Ultra isn't enough, but because they are CPU-limited or lack RAM.

SLI In The Future

NVIDIA hasn't divulged the maximum number of cards that SLI supports (irrelevant at this point since motherboards with more than two PCI-E x16 connectors don't exist); but, there's speculation that the technology will expand to enable elaborate graphics workstations wielding more than two video cards.

In the more immediate future, NVIDIA plans to ship its nForce4 chipset for AMD's Socket 939 Athlon 64 processors in three different flavors. The flagship product, nForce4 SLI, will feature 20 PCI-E lanes and two PCI-E x16 slots. If you plug one video card into a motherboard sporting the chipset, it will enable all 16 lanes, reserving four for peripheral PCI-E x1 devices. On the other hand, installing two cards sets each slot to run at x8. George Myers, nForce 4 product manager, says that rearranging the PCI-E slots won't have an adverse effect on performance. The chipset will also support Serial ATA II and some additional security features, giving the Athlon 64 a much-needed modernized platform.

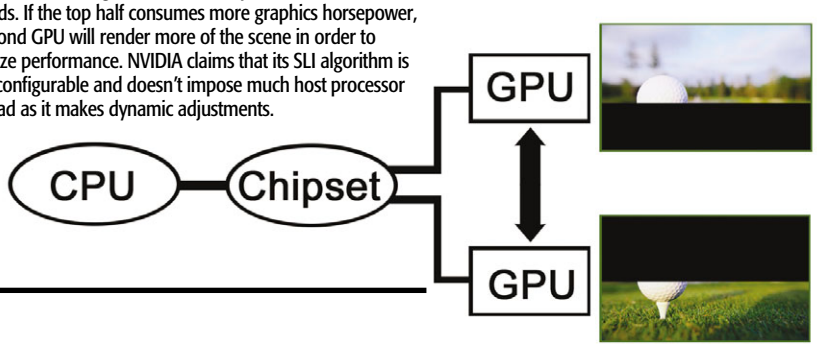
VIA also claims to be developing core logic with multiple PCI-E graphics slots. Its upcoming K8T890 Pro and PT894 Pro chipsets will expose the feature on both Athlon 64 and Pentium 4 platforms. VIA's Richard Brown says they should be available by the end of 2004.

The Future Is Now

NVIDIA reps are saying that it will be possible to buy SLI-equipped systems this fall. At least initially, the company's plan is to offer SLI through qualified system builders, an approach that makes a good deal of sense when you consider the technology's hefty requirements: There's the necessary motherboard, graphics cards, link connector, and an extremely robust power supply. CPU

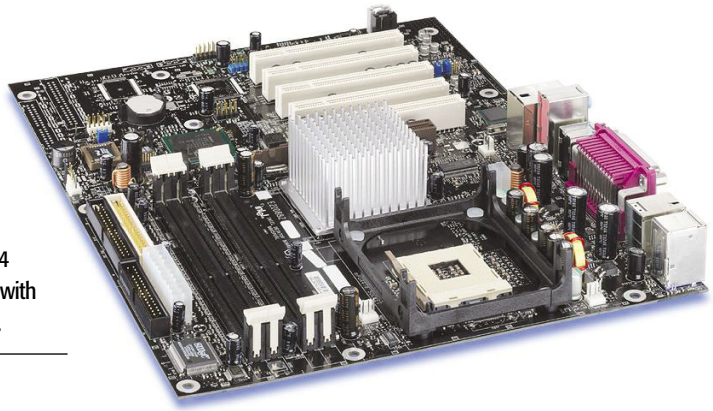
by Chris Angelini

In this illustration, independent graphics processors dynamically balance the rendering load based on a particular scene's demands. If the top half consumes more graphics horsepower, the second GPU will render more of the scene in order to maximize performance. NVIDIA claims that its SLI algorithm is highly configurable and doesn't impose much host processor overhead as it makes dynamic adjustments.



Our Top Tips For Motherboards

The Three Bs: Buying, Building & Bug-Hunting



Intel's D865PERL is an ATX mobo designed to support Intel's P4 Extreme Edition with an 800MHz FSB.

Those of you looking to eke maximum performance out of your system know the choice of motherboard is a critical consideration. Sure, other components get all the press, but experienced modders know a top-of-the-line CPU needs a top-of-the-line motherboard to achieve its performance potential.

Think of it this way: You wouldn't retrofit a Porsche with a Yugo engine, right? So why in the world would you want to saddle that Pentium 4 Extreme Edition with anything but the latest generation chipset and mobo? From PCI Express to DDR2 memory to Gigabit Ethernet, you need cutting-edge technology to feed that data-hungry cutting-edge P4. We'll give you many great tips to keep in mind as you get ready to build that screaming performance rig. So without further ado, here are our tips for buying, building, and bug-hunting, motherboard-style.

Buying

The most important decision you'll make is buying the right motherboard. The market is full of choices, so the right board is out there waiting. Here are some buying tips to help you make the right choice:

1. Do Your Homework. The key to purchasing the best possible motherboard is to thoroughly research your options before you buy. From printed media to the Internet, there is a large number of great information resources available for your use. Many motherboard manufacturers' Web sites share plenty of information about their products, including product manuals, photographs, and specifications.

2. Share The Battle Stories. Numerous discussion groups all over the 'Net are dedicated to debating the pros and cons of all types of hardware, including motherboards. Check them out because product discussion groups can be a gold mine of information. After all, do you really want to buy a board that's getting universally bashed all over the Internet?

Here are a few sites where you can swap mobo battle stories with other modders:

- ***Computer Power User*** **magazine:** www.cpumag.com
- **Tom's Hardware Guide Community** www.community.tomshardware.com/forum/categories.m
- **AnandTech** forums.anandtech.com/categories.cfm?catid=29
- **ExtremeTech** discuss.extremetech.com/n/main.asp?webtag=extremetech&nav=messages
- **Sharky Forums** www.sharkyforums.com

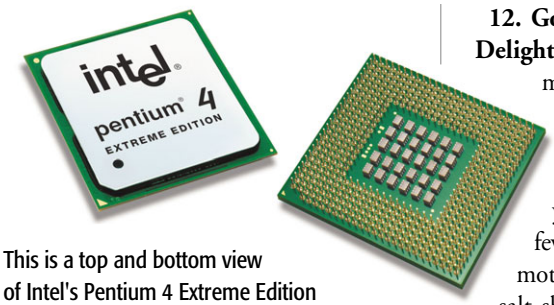
3. AMD vs. Intel: Pick Your CPU. There are numerous resources in the print media and on the Web dedicated to endlessly studying and benchmarking the latest offerings from Intel and AMD. And Intel and AMD devotees are both equally passionate about the superiority of their favorite chip. One thing's for sure: Both are very capable chips that will perform most computing tasks with ease.

4. Memory: The Rise Of DDR. Most motherboards today use DDR memory. Once upon a time, Rambus' RDRAM was the memory of choice for P4 systems. Now that Intel and Rambus parted ways, DDR memory dominates the marketplace. The choice of chipset (see next tip) will determine the type of memory you can use on your motherboard. Most mainstream and cutting-edge chipsets today use DDR2 (dual-channel DDR) running at 400MHz, 333MHz, or 266MHz.

5. Don't Forget The Chipset. The chipset is the conduit that links your computer's CPU to the various other peripherals and components in your system. Matching your CPU with a suitable chipset is a critical decision. You definitely don't want to make the mistake of crippling a state-of-the-art CPU with a chipset that doesn't support all its features.

6. Peripheral Considerations. Look for a board with plenty of USB and/or FireWire ports. Most new motherboard models should come with enough USB 2.0 or FireWire ports to eliminate the need to buy any add-in cards. Look for boards with support for six or more USB 2.0/1.1 ports and at least one FireWire port.

7. Built-In vs. Standalone Graphics. Some motherboards, such as those featuring Intel's new 915G Express chipset, have built-in graphics capabilities. Most hardcore gamers and performance PC enthusiasts avoid motherboards with built-in graphics and prefer to purchase cutting-edge standalone graphics adapters. But if having the latest graphics adapter is not so important to you, then buying a



This is a top and bottom view of Intel's Pentium 4 Extreme Edition CPU, which packs a whopping 2MB L3 cache.

board with built-in graphics might save you a few dollars.

8. Built-In vs. Standalone Sound. Most motherboards sold today feature built-in audio controllers that perform fairly well. But if you are an audiophile who absolutely requires the most cutting-edge audio features, you will want to go with a standalone audio card.

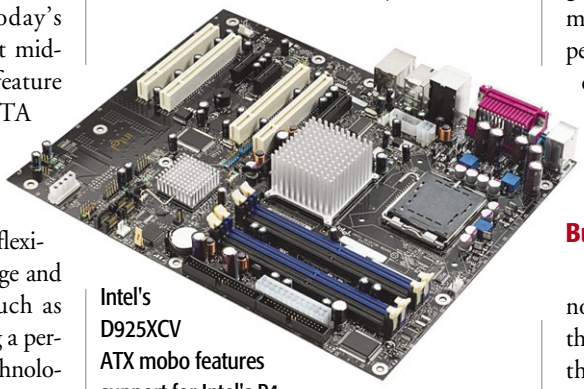
9. Storage Options. There are plenty of storage options available with today's motherboards. For starters, a decent middle-of-the-pack motherboard will feature onboard UDMA 100/66/33 and SATA controllers. The more expensive cutting-edge boards packing the latest chipsets feature RAID controllers, so they provide maximum flexibility for setting up a variety of storage and data protection configurations, such as RAID 0, 1, or 0+1. If you're building a performance PC that needs the latest technology, RAID is a must.

10. How About Legacy Ports? Most peripherals today, including printers and scanners, connect to your PC via USB and don't even have legacy port connections. Many board manufacturers are not adding legacy ports to their boards. If you plan to use devices that need legacy ports, buy a board with the ports you need.

11. Get Connected. LAN connectivity is now ubiquitous; you can't even connect your computer to a broadband DSL or cable modem without an available Ethernet port. To help you get connected, most mobos have built-in LAN controllers. Look for a board with at least a 10/100Mbps controller; cutting-edge boards will include Gigabit LAN controllers, and we've even seen some new boards with built-in wireless LAN controllers.

12. Going Jumperless: Overclocker's Delight. In past, overclocking a system meant opening your PC case and fiddling around with jumpers. Now, many boards have BIOSes that make overclocking your system as easy as changing a few settings in your BIOS menus. A motherboard worth its overclocking salt should let you, at the very least, adjust the FSB frequency and the CPU's core voltage.

13. Monitoring Options: A Must If You Overclock. If you are planning to overclock, it's a good idea to keep an eye on the temperature and voltage of your system's components. The last thing you need is to fry that expensive P4 or Athlon 64. Look for a board with a BIOS that displays temperatures, voltages, and any other information you might need to monitor system health.



Intel's D925XCV ATX mobo features support for Intel's P4 Extreme Edition, PCI Express, DDR2, Gigabit Ethernet, and others. If you're looking for a micro-ATX form factor, go with the D925XBC mobo.

14. Tools To Get You Out Of Trouble. Some motherboard BIOSes now include auto-recovery features that allow system restoration to a previous setting without having to clear your CMOS. Simply boot from a recovery CD and follow the instructions for restoring your system. The bottom line is, if you want to experiment with overclocking, buy a board that has plenty of options for restoration and recovery.

15. Form Factors: Size Does Matter. Modern PCs are not only the best ever in terms of performance; they are gaining style points by evolving beyond the dated "beige box" case designs of old. As a result, motherboards also evolved; there are now five standard form factors (ATX, micro-ATX, Flex-ATX, Mini-ITX, and NLX) and a number of proprietary designs from PC manufacturers. An ATX form factor is the most flexible: It works with desktop, mini, and full tower cases. Get a board that's built for the type of case you want.

16. Check Out The Upgrade Path. This may seem obvious, but it's a good idea to keep the CPU upgrade path in mind when you purchase a board. If you plan on swapping CPUs frequently, you are better off purchasing a newer, more cutting-edge board that will accommodate upcoming versions of new CPUs as they arrive.

For example, the ASUS P5AD2 Premium board supports Intel's latest and greatest P4s and has enough cutting-edge goodies (such as PCI-E and DDR2) to make it a suitable board for future P4s and perhaps beyond. If you purchase a middle-of-the-road or lower-tier board, you will most likely end up replacing both the motherboard and the CPU when you upgrade.

Building

This is where the fun begins. There is no better way to intimately get to know the hardware details about your computer than installing your own system board. Although most motherboard installations should go smoothly, there are pitfalls that can ensnare the unwary. Here are some tips that will help you carry out your next PC building project without a hitch.

17. Consult The Web. Just because your motherboard came with a nice, new manual doesn't mean it's up-to-date. Before you begin the installation process, go to your board manufacturer's Web site and make sure you are up-to-date on any late-breaking developments with your board. Is a BIOS update available from the manufacturer? Are there any quality defects you didn't know about when you bought the board? Make sure you check it out before you install.

18. Prepare Your Work Area. Set aside a comfortable, well-lit work area with plenty of space and free of distractions. Make

sure you have all the cables, peripherals, screws, tools, and manuals you will need. Be organized.

19. Prepare Your Old Stuff. If you're upgrading an older computer, make sure you back up all the data you want to keep to a safe location, preferably a CD or some other type of backup media. Take an inventory of your existing programs and set aside the installation CDs and registration keys you will need to reinstall your programs into your reconfigured computer.

20. Check The Contents. Halfway through your installation is not the time to find out your motherboard didn't come with a required cable or the manual or drivers CD. Before you begin, take inventory of the contents inside your board's box and make sure all the items you paid for are present.

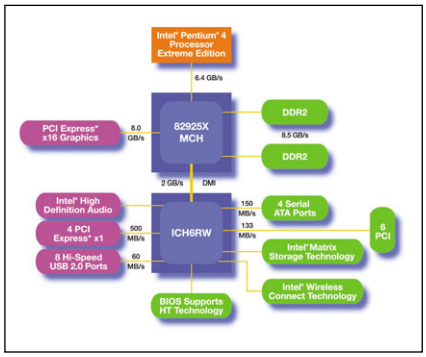
21. Beware Of St. Elmo's Fire! Static electricity is your motherboard's worst enemy. A bolt from you finger can destroy your board, so take precautions to prevent static electricity. Many computer toolkits come with antistatic wrist straps that disperse static electricity. If you have one, use it. If you don't have one, ground yourself by touching a metallic, unpainted surface on your PC's case before you start working.

22. Be Gentle. Most motherboard slots and/or sockets are designed so electronic components fit only one way. If you are struggling to insert a component, such as a video card or memory module, you are probably doing it wrong. Don't force things into place; this is not the time to show off your strength. Take a deep breath, stand back, and study the socket or slot where you are inserting a component. Better yet, consult your manual.

23. Working With The Case. Many new computer cases now include a very convenient feature: removable motherboard panels. Before you start, verify whether your computer case has one of these. If so, remove it and work with the panel itself, away from the case. This will make it much easier to install your board.

24. Things That Go Bump. If your PC's case does not have a removable panel, be careful when moving things in and out of the case. A PC case could have sharp metallic edges that can easily give a finger a pretty good slice. And be careful when moving components, especially hard drives. It's pretty easy to accidentally bump a component and cause unwanted damage.

25. Find The Holes. The case panel on which the motherboard will rest should have mounting holes that match with the holes on your system board. This step simply involves matching up the holes in the case with the holes on the board and using the screws supplied with your board to attach the board to the case. Easy does it: Begin by finger tightening everything and then slowly tighten everything down with a screwdriver. The key is to ensure your board is securely attached to the case.



Here's a diagram of the architecture of Intel's 925X chipset, designed for the Pentium 4 Extreme Edition. The 925X supports DDR memory, PCI-E x16 graphics, Hyper-Threading technology, and other goodies.

26. Handle With Care. We've already discussed static electricity and how it can damage electronic components. Well, the natural oils and other contamination on your hands and fingers can also cause problems with delicate electronic components, especially your motherboard. Always handle the board by the edges to avoid touching the delicate circuitry on the board's surface with your hands.

27. Check The Power. Many spurious, difficult-to-troubleshoot problems can be traced to an insufficient power supply. Beyond your motherboard, components such as today's high-end, power-hungry CPUs, memory modules, graphics adapters, and even hard drives place tremendous demands on power supplies. Do your homework and use a power supply that can handle the load.

28. CPU Care. When installing the CPU, carefully and thoroughly read all instructions. The pins underneath the CPU align with the holes in the socket one way, so study the motherboard manual and any illustrations describing the process before proceeding. Be patient and do it right.

29. Memory Prep. Before installing the memory, check with the manufacturer and make sure you have the right memory configuration. Some motherboards require installation of memory modules in pairs for optimal performance. Like the CPU, memory modules only fit into the slot a certain way; a notch in the memory module should match with a corresponding key in the memory slot. When everything is properly aligned, the module snaps into place.

30. Hard Disk Considerations. If you are installing a SATA hard disk, you'll be pleased to see that the old IDE flat ribbon cables are now replaced with much narrower cables. If you are installing an IDE hard drive, line up the No. 1 hole in the cable's connector to the No. 1 position on the motherboard controller's slot. This side of the ribbon is usually marked with a red stripe, so it should be easy to see. Press the ribbon's connector into the slot, firmly but gently. The motherboard can be cracked or split if you exert too much force.

31. Card Care. Most components sold today, such as graphics adapters, come in plastic antistatic bags that prevent static damage to the component. Keep these components in their bags until you're ready to use them. And when you handle them, pick them up by the edges and avoid touching the surface of the component.

32. It's Alive! After everything is installed, turn on the juice. The computer should boot normally. At the beginning of the boot process, the BIOS displays a message such as Press F10 To Enter Setup; press the appropriate key to enter the system BIOS. Most BIOSes today automatically configure devices such as hard disks or CD-ROM drives. Navigate the BIOS menus and verify every device you installed is present and correctly configured.

33. An Update Already? While you are navigating your new board's BIOS, check

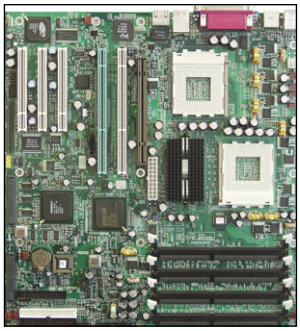
the date and version number of the BIOS and write these down. Now go to your board manufacturer's Web site and find out if a new version of your system BIOS is available. If so, follow the manufacturer's instructions to download the update and flash your BIOS. Nearly all BIOSes today can be flashed. Just follow all instructions to the letter.

Bug-Hunting

Most of the time, there will be no problems when you turn on the power and fire up your new system. But computers are complex devices, and even the most careful installer will occasionally run into problems. Here are a few tips for dealing with motherboard problems.

34. Learn The Beep Code. To help troubleshoot problems that occur very early in the boot process, your system's BIOS has a system of audible beep codes that describe various types of system problems. Have a copy of your BIOS manual handy and know what the various beep codes mean. That way, if trouble strikes, you will have some idea of where to start the troubleshooting process.

36. Look Ma, No Video! Most BIOSes will report an improperly inserted or defective graphics adapter via a beep code. If you boot the PC but see no video, check for an improperly inserted graphics adapter first. If the graphics adapter is properly inserted but the video still doesn't work, you may have a defective graphics adapter.



Tyan's K7X Pro mobo supports two Athlon MP processors and features an extended ATX form factor.

37. An Absentee Hard Drive. If the hard drive shows no signs of life, check that the hard drive's power connector and IDE (or SATA) cables are properly connected. It's easy to be a bit too gentle when plugging in the IDE connectors. If all connections look secure, your hard drive may be defective.

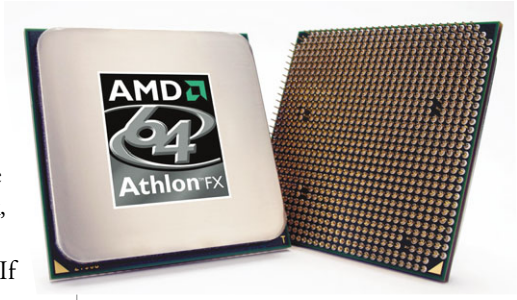
38. Down For The Count. One of the first tasks performed by the system BIOS is a count of the memory. If the BIOS reports the wrong amount of memory, check the memory modules to ensure they are properly seated. If the memory modules are properly seated, you may have a defective module. You can check each module by rebooting your system with just one module inserted. If none of the modules work, your motherboard may be defective.

39. When Nothing Happens. If you turn on the system and nothing happens, check the power supply first and verify that all power connectors (especially the one supplying the motherboard) are properly connected. Eliminate the obvious (is the computer plugged in?) and move on to the most difficult (is the motherboard defective?). An underpowered power supply, especially with a system full of top-tier components, is usually the culprit behind this symptom. For a top-notch system, use a power supply with at least 400 watts.

40. When Fireworks Happen. Loud pops and sparks and smoke spewing from the back of your newly built PC are not a good sign. If this occurs, it is most likely because of a defective power supply. Unplug the electricity to the system and replace the power supply. Hopefully, your motherboard and other components will survive the explosion unscathed.

41. Strange Freezes, Crashes: Part I. If you are overclocking your system and experience intermittent crashes and/or freezes, you may want to throttle back on your overclocking. When you overclock your CPU, the chip runs faster and generates more heat. That heat, if excessive, can cause performance problems; in extreme cases, you could permanently damage your CPU. Overclock with care.

42. Strange Freezes, Crashes: Part II. If you are not overclocking but intermittent crashes or freezes are hampering performance, check for insufficient cooling. Today's hot-rod CPUs and peripherals all run very fast, but that speed comes at a price: increased heat. Improperly cooled systems will suffer performance problems due to excessive heat.



AMD's Athlon 64 FX is the world's first consumer 64-bit processor. The Athlon 64 comes in two flavors: the FX-51 running at 2.2GHz (Socket 940) and the FX-53 running at 2.4GHz and available for Socket 940 and Socket 939.

43. Finicky Fans. If you don't hear your system fans at boot time, turn off all power to the system immediately and verify the power connectors for the fans are all properly inserted. Check the fan or fans that are not working properly and replace them if necessary. A fan is a cheap item to replace, but a brand new P4 is not. Don't let cooling problems demolish your pocketbook.

44. Mistaken Identity. When you first boot your system, the BIOS may report the wrong speed or type for your CPU. If this occurs, check for a new version of the BIOS firmware; if an update is available, flash the BIOS. If your motherboard's configuration is set with jumpers, verify you have the jumpers properly set for the type of CPU you have. You can also verify the BIOS settings that report the CPU type and speed and correct those if needed.

The Highway

The motherboard is the nerve center of your system, the highway through which all of your system's data flows. It is perhaps the most critical component in your PC's case; without it, all the rest of the devices in your system are isolated components unable to communicate. The motherboard is a complex device, but if you are methodical in your approaches to buying, building, and bug-hunting, the odds are excellent that your system building adventures will go without a hitch. CPU

by Sixto Ortiz Jr.

Mighty Motherboard Toolbox

A Quick Roundup Of Geek-Friendly Mobo Widgets

Motherboard-related gadgetry clogs retail Web sites, and with so many doodads, dongles, and doohickeys available, it's easy to overlook those that are really useful. As a result, you might end up wasting technobucks on stuff that's practically worthless, or at least not as cool as the toys you've seen other people playing with at local LAN parties. We'll sift through some common motherboard tools and toys to give you the scoop on what's cool and what's for fools.

Ultra 13-Piece Adapter Kit

You've played with spring-loaded retractable phone lines for hours at a time. But with this 13-piece cable kit from Ultra, you'll be entranced for months. It includes two types of USB cables, one FireWire cable, an RJ-45 cable and an RJ-11 cable (all are retractable), and an assortment of adapters, as well as a headset with a microphone and a USB mouse. In addition to reducing cable clutter, this kit comes with a carrying case to reduce messes and tangles.

The case looked and felt like a high-quality piece of gear, and the high-density foam inside retained the adapters well. However, the mouse refused to stay put, flopping out onto our desk at every opportunity. The adapter and cable extensions were clearly marked, and they felt solid, but we experienced occasional tangles when retracting the cables. If you used tape or some other low-tech method to secure the mouse, this kit would be worth the price.

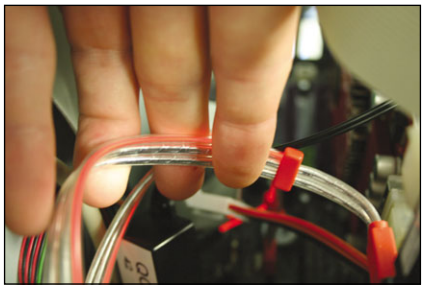
We paid: $60
Available at:
www.tigerdirect.com
www.amazon.com

This Ultra adapter kit includes retractable cables and adapters to help you conquer just about any port problems.

EL Serial ATA 150 Cable

SATA (Serial ATA) cables are sleeker than their old IDE counterparts, but as every modder knows, there's always a way to make a cool product even cooler. This 18-inch cable is embedded with an electroluminescent strand that helps it illuminate the dark recesses of your case. You can pick different colors, such as red or blue, to match your case's color scheme.

We bought the red version to see for ourselves how much our case's coolness factor would rise. After we unpackaged our new toy, we saw that the EL wire was molded to the side of the silvery cable, and as a result the cable was wider than normal. The lighting effects required the use of the included inverter, which connects to a four-prong power plug from the power supply. In bright office light, the cable's glow was not that impressive. But in darker rooms, and with other mod-minded toys installed, these cables would be a nice touch.



We're suckers for PC-related glow toys. This one happens to be a glowing SATA cable that comes complete with its own inverter.

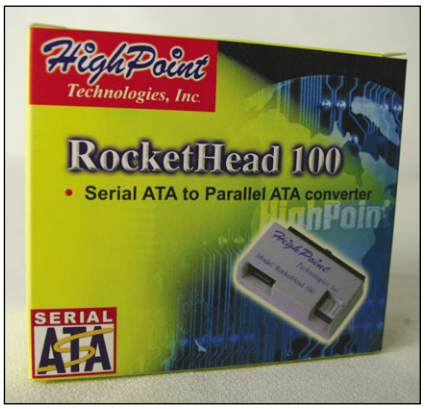
We paid: $8.99
Available at:
www.directron.com
www.xpcgear.com

HighPoint RocketHead 100 Serial ATA Converter

According to the product description, this converter lets you turn an IDE hard drive into a SATA drive. Skeptics, start

your engines. We ordered one of these devices that claims to let your hard drive access bus bandwidth of up to 150MBps, even though the fine print indicates that "final performance depends on your hard drive's specs."

To set things up properly, we connected the RocketHead to the IDE port on the back of our hard drive and then connected



The RocketHead 100 SATA converter is designed to give your IDE hard drive a speed boost. It comes with the SATA power splitter you need for your IDE drive.

a power supply plug and SATA cable to the converter. After performing these simple steps, we fired up HD Tach to see if this application indicated any improvements in data transfer. As one of our IT gurus predicted, there was no appreciable change in hard drive performance. So why would you want one? Well, if you don't have a SATA hard drive but want to free up an IDE header, this is a good option, and doing so also lets you use skinny SATA cables in place of wide IDE cables. For a truly speedy hard drive, though, you'll likely have to upgrade to a real SATA drive.

We paid: $15.99
Available at:
www.directron.com
www.xpcgear.com

CableClamps (large)

They're expensive as all get out, but darn it, they're *cool*, which is something you can't say about most cable organizer products. The CableClamp, which we reviewed in the large size, is made of rugged polymers and stainless steel and ostensibly puts these simple tools into the "heavy-duty" category.

We selected the large version of the CableClamp, but to our surprise, this model was actually bigger than the palm of our hand, and when extended, bigger yet. The clamp worked like handcuffs, with a toothy section that snapped into the clamp's other half; we released the clamp with a thumb lever. The large model was big enough and strong enough to secure a handful of cables with no stress on either the CableClamp or the cables themselves. However, for in-case wiring, you'll want to stick with the smaller version.

CableClamps are the most ruggedly built cable organization products we've seen. They're made of super-tough plastic and stainless steel.

We paid: $2.99
Available at:
www.frozencpu.com
www.cableorganizer.com

7-inch Zip Ties

If you can't afford CableClamps, you can always fall back on the old faithful cable organizer: plastic zip ties. Be sure to buy long ones, such as these 7-inchers, because shorter ties are harder to manipulate in the corners of your PC case.

There are a couple of drawbacks to zip ties. For starters, you can only use them once. And removing these ties without sturdy scissors or other tough tools is almost impossible. But these ties cinch just as tight as you want, and once you put them in place they rarely move, a big plus for those of you who are neatness challenged.

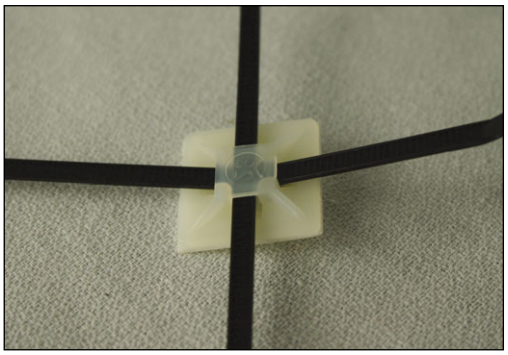
We ordered some of these ties to, uh, make sure they worked. After testing these for 10 seconds we came to the conclusion that they are definitely tough and durable enough for general use. Better yet, these ties are a standard width, which lets them work in tandem with the following product.

We paid: $1.50 for 10
Available at:
www.frozencpu.com
www.cableorganizer.com

Self-Adhesive Mounts For Zip Ties

Sure, zip ties help cinch wire cables together in nice, neat bundles, but those bundles all too often end up swinging blithely in the breeze, waiting to cause a fan catastrophe. What you really need is an inexpensive and aesthetically acceptable way to keep those zip ties and their payloads out of harm's way. Here's your answer: self-adhesive mounts for zip ties.

We bought a 10-pack of self-adhesive squares designed to secure zip ties to a flat surface. Wafer-thin and about an inch square, these sticky-backed plastic tabs have four slits that let you insert two zip ties, one from either side. Then stick the tab to the inside of your case, push wires and cables into reach of the zip ties, close the tie, and the bundle stays put. We pressed a tab to a case-like metal surface and tugged, yanked, and pulled to see how well the glue worked. Suffice it to say you won't have to worry



Self-adhesive zip tie mounts bring the zip tie organization scheme full circle. They help you keep your wire bundles out of the way.

about a few unruly cables pulling these mounts away from their target surface. Removing these tabs is another matter altogether and best left to users who are experts with razor blades and solvents. In conclusion, here's a buying tip: Purchase these in bulk to save a wad of cash.

We paid: $1.75 for 10
Available at:
www.buycableties.com
www.frozencpu.com

VioMax IDE Hard Drive to Serial ATA 150MHz Converter

Are you laughing yet? OK, so it's another IDE-to-SATA converter, but this time the price is more reasonable and the build quality, at least on the Web site, looks much better than the other converter we tried. The device comes in a solid, transparent plastic case that's more attractive than the RocketHead model we reviewed earlier in this article.

This device required the same kind of setup as the RocketHead, only with this product, the manufacturer didn't include the power splitter for the converter. This didn't stop us from executing our tests, though. Once we finished with HD Tach again, however, our disappointment was palpable because there was no noticeable performance improvement.

Other users have reported minor speed boosts (from 1% to 3%) using these kinds of adapters. But after considering the price/performance ratio, we think the benefits are negligible. Save your money for a real SATA hard drive instead.

We paid: $22
Available at:
www.pcpartscollection.com

Universal Molex Pin Extractor

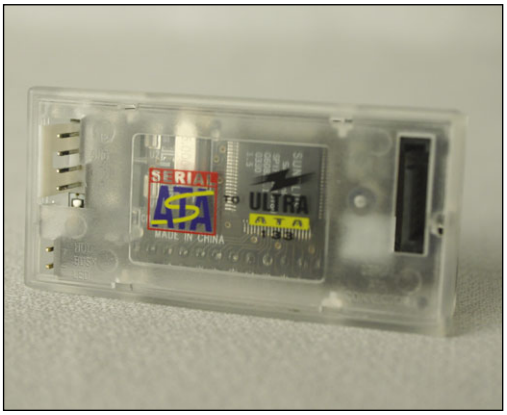
Extracting Molex pins is like pulling teeth, only the plug doesn't have bad breath or threaten to bite you. Pulling pins is more difficult than yanking canines unless you have a handy extractor, like this one, to help you do the job. Of course, you can always take the shortcut, cut off the whole plug, and splice things back together, but then your friends would point and laugh. And we can't have that.

Then again, they'll probably do their fair share of snickering while watching you try to use this blasted tool. After consulting two IT experts, neither of whom was able to extract a pin using this tool, we decided that this particular product is less effective than a pair of needle-nose pliers, and the flimsy plastic construction guarantees it sure won't last long. No thanks.

We paid: $2.99
Available at:
www.frozencpu.com
www.directron.com

Back-up Q EasyGo USB 2.0 to IDE Adapter Cable

This is one of those little gadgets that you wished you had found years ago: An oddly named adapter that lets you transform an IDE storage device into a USB storage device. That means you can opt for the convenience of an external hard drive without paying the trumped-up prices. What's more, you can convert any internal IDE drive into an external version. Or that's at least part of the idea, anyway. After the IDE-to-SATA converter debacle, we were a little skeptical.



The VioMax IDE Hard Drive to Serial ATA 150MHz Converter is supposed to help give new SATA life to your old IDE drive. We were surprised by the results.

As it turned out, this was a marvelous product. It comes with a variety of adapters and its own power supply, so you have enough tools to convert everything from a CD-ROM drive to a notebook PC hard drive. We tested a 5,400rpm IDE hard drive, and within minutes we had formatted the drive and started to transfer files, all via the USB port. Considering the flexibility this product offers, we think it's one of the best investments we've ever seen in this price range, especially when you recall the price premium on external devices.

We paid: $31.95
Available at:
www.compgeeks.com
www.pcmicrostore.com

Other Add-In Products

We didn't have enough time to review the entire range of products available to users who want to hop up their motherboard and overall system capabilities. But rest assured, we rounded up more of the tastiest tidbits sure to pique the interest of your inner geek and make your PC experiences more efficient.

IDE to SATA Power Adapter

Raise your hand if you're one of the absent-minded folks who ordered an OEM SATA hard drive to replace your old, 40GB IDE monstrosity and forgot that your PSU doesn't provide an appropriate power connector. Don't worry; you aren't the only one, and fortunately, there's an easy way to make your shiny new drive work with an older PSU.

All you need is an IDE to SATA power adapter that you can find from many different online retailers. This adapter lets you connect a 4-pin PSU connector into a 15-pin SATA connector, and as a nice benefit, adds some

length (7 inches or so) to the PSU power cable.

Approximate price: $3
Available at:
www.directron.com
www.newegg.com

USB 1.1 to PS/2 Keyboard and Mouse Adapter

Although PS/2 and USB ports are ubiquitous in both desktop and notebook PCs, there's always a situation where you wind up with one too many connectors with nowhere to go. If you want to connect a keyboard or mouse to a PC and the PS/2 ports are occupied, buy an inexpensive USB to PS/2 adapter.

This device will let you connect your two most common input devices to a single USB port. It's self-powered so you don't need a wall outlet to make it work, and it comes with a 16-inch cable to make sure you have plenty of slack during energetic Doom 3 outings.

Approximate price: $10
Available at:
www.tigerdirect.com
www.usbgear.com

CPU Security Lock

Modded computer cases come with huge, clear windows that boast of the super-expensive electronics within. Yet few PC cases, even those with more businesslike styling, can ward off sticky-fingered coworkers driven mad by gadget envy. A computer security lock can stop such casual thieves.

These locks are easy to use—you replace a case screw with the lockable device—and you can take the key with you to restrict case access. Although perhaps overly simplistic, and certainly not exactly a heavy-duty security product, these locks should be enough of a deterrent to stop other employees from snagging PCI cards or other easily removable parts. You'll probably need two of these locks to offer your computer a decent level of protection.

Approximate price: $4
Available at:
www.directron.com

This Universal Molex Pin Extractor is designed to make PSU-related jobs a snap. Just push this device into place and it supposedly helps you remove pins with ease.

Case & Cable Labels

Say it 10 times fast: Case and cable labels! Case and cable labels! If you're like us, you were ecstatic when the powers that be finally started using color-coded PS/2 ports and connectors for mice and keyboards. This kit, which contains labels for your case and cables, will let you color code many other parts of your PC, from LAN ports to DVD drives.

We think the biggest benefit of such a system would be for labeling ports, which are easy to identify in broad daylight but much harder to discern when you're crawling around in the cobwebs beneath your PC desk. The labels are made from a plastic material, and you can write on them using a pen or pencil. The sticker assortment contains some tired jokes, such as the Panic and Help button stickers, but for two bucks, we don't think you'll mind putting up with lame techie humor.

Approximate price: $2
Available at:
www.directron.com

Zalman Motherboard Heatsink

Your CPU is an obvious source of heat, and so is your GPU, but sometimes your mobo's northbridge chipset gets overlooked as a heat-producing problem, especially with overclocked PCs. If you suspect your chipset's heat levels are making your system fussy, this heatsink might be of help. In addition to the heatsink, this kit includes thermal grease, necessary hardware, and instructions.

One of this heatsink's best attributes is that it doesn't need a fan to dissipate heat, so it won't contribute to computer noise. However, you do need to make sure that the heatsink isn't surrounded by a lot of other components, so you'll want to make sure your case fans offer at least a little airflow and also keep wind-blocking IDE cables far out of the way.

Approximate price: $7
Available at:
www.endpcnoise.com
www.case-mod.com

Cardkeeper

If you're a LAN party addict, you're probably familiar with the frustration of arriving onsite and finding your PC won't boot properly. After 10 minutes you figure out that a cable or PCI card is loose. The Cardkeeper promises to reduce the occurrences of loose AGP and PCI cards. As it's nothing more than a basic plastic clip, we figured this product was a little overpriced. However, other users have reported good success with the Cardkeeper. Be sure to buy the right size to ensure it fits properly. Some retailers offer only the most popular, medium-sized clip, and this one won't work for oversized video or expansion cards.

Approximate price: $4
Available at:
www.directron.com
www.performance-pcs.com

D-Link Air 2.4GHz Wireless USB Ethernet Adapter

You can buy PCI cards for desktops and PC Cards for notebooks, but devices that provide wireless access are a pain if you're already using those slots for other hardware. Why not use every available port?

This USB adapter lets you use a wireless dongle that works through your USB port. The adapter is compatible with 802.11b wireless networking equipment and works with 64- or 128-bit WEP encryption and WPA encryption.

Some users claim that this device doesn't play well with routers that aren't made by D-Link, and others say that its reception

isn't on par with full-sized PC Card receivers. But if you need a compact way to snag wireless access, this tiny device might well help you work in spite of your glut of PC Card components.

Approximate price: $40
Available at:
www.newegg.com
www.dlink.com

D-Link 7-Port USB Hub (Model DUB-H7)

You can never have too many USB ports. And you can never have too many High-Speed USB 2.0 ports that are backward-compatible with USB 1.1, which is why you might want D-Link's seven-port USB hub when you have a lot of devices to use.

This isn't a travel-worthy hub for your notebook PC. This is a heavy-duty hub that requires its own AC power supply, and thus, a nearby power outlet. At 3.9 inches wide x 2.3 inches deep x 1 inch high, this device has seven type A downstream ports and one type B port so you can connect the hub to your PC, and it includes colored LEDs that keep you updated on port and power status. Because older USB 1.1 ports can't take advantage of this device's fast transfer speeds, make sure your PC has high-speed ports; if not, you can find more affordable hubs that use older USB 1.1 technology.

Approximate price: $40
Available at:
www.newegg.com
www.tigerdirect.com

SIIG USB2.0, FireWire, SATA Combo PCI Card (Model CN2507)

Your aging desktop PC is lagging behind the times, with too few High-Speed USB 2.0 ports, no FireWire ports, and perhaps most regrettably, no SATA connectors for that nifty new hard drive you've been eyeballing. Oh, and you have only one vacant PCI card slot. This combo card from SIIG lets you add all three capabilities for one reasonable price.

Slide this card into your motherboard and you'll instantly have three external USB 2.0 ports, two external FireWire ports, and one internal port of each type. In addition, you'll have two internal SATA ports that work on independent channels and thus let you connect two different SATA-compatible drives. In the box, you also get two other necessities: a SATA data cable and a 15-pin SATA power cable.

Approximate price: $95
Available at:
www.newegg.com

IOSS BIOS Savior

Recipe for disaster: Attempt to update BIOS on your motherboard. Accidentally transfer firmware-scrambling virus. Ta-da! Suddenly your BIOS, and thus, your motherboard, are rendered inoperable. You can combat these kinds of problems with the BIOS Savior, which is pretty much an adapter board with a backup BIOS chip that you can use in case of emergencies.

Back-up Q
USB 2.0 IDE Adapter
Extend High-Speed Capabilities
Connectors: USB A port to IDE 40-pin female.
Fully compliant with USB 2.0 & USB 1.1.
High-Speed up to 480 Mbps data transfer rate. (Max)
Integrated USB Transceiver.
Easy Go

The Back-up Q EasyGo USB 2.0 to IDE Adapter Cable helps you convert internal drives into external drives. It's an incredible deal when you consider its low price.

To use the BIOS Savior, you start by pulling out your mobo's BIOS chip using the included chip puller tool. Then you insert the Savior adapter and reinstall your mobo's BIOS chip to the top of the adapter. In many cases, you can simply restart your computer and it will load properly.

But before you can even begin to use this nifty device, you'll have to be sure you buy the version that works with your brand of motherboard. This link—www.ioss.com.tw/web/English/RD1BIOSSavior/RD1List.html—will help you find the Savior that will guide you to your motherboard's salvation.

Approximate Price: $25
Available at:
www.frozencpu.com
www.mwave.com

DVI-A to SVGA Video Adapter

The DVI standard is great for videophiles, but as with all advances, this one introduces new problems along with its benefits. One of the main problems is that you might not always have a DVI-capable monitor that works with the DVI connector on your video card.

This adapter lets you use an SVGA monitor with a DVI video card. The adapter works because it takes the 14-pin DVI-A Out port and converts it into a standard, 15-pin SVGA port that functions with just about any monitor.

Approximate price: $7
Available at:
www.compgeeks.com

Adaptec USB To SCSI Converter

Even if your home PC comes with SCSI capabilities, there's no guarantee that your friends' or co-workers' PCs will be similarly equipped. That could hamper your ability to use a SCSI Zip drive, scanner, CD-ROM drive, or other device unless, of course, you have the appropriate USB to SCSI converter.

This Xircom converter isn't cheap, but it does let you connect up to seven SCSI components to one USB port, and you don't need to install additional parts to make it work. The converter works at speeds of up to 12Mbps and comes with a detachable 6.5-foot cable, and it doesn't require a separate power supply. Two LEDs, one for power and one for data transfer, help you keep tabs on the device's status.

Approximate price: $70
Available at:
www.laptoptravel.com
www.compusa.com

More Tools Than Money

These mini reviews and product descriptions will give you a better idea of the kind of pampering you can give your motherboard. We know most of you can't afford to go out and buy all of these tools at once, but keep them in mind for your future shopping sprees, because a hopped-up motherboard is a happy motherboard. CPU

by Nathan Chandler

MOBO Q&A

Delve Deeper Into The Motherboard Market

With the plethora of motherboard manufacturers and configurations on the market, choosing the right one can be a daunting task for both the enterprise and individual user. Additionally, advances in technology such as onboard firewalls and updates to unchanged features such as the BIOS and PCI bus are trickling into the market. Mobos are shrinking in size, growing in computing power, and being utilized in nontraditional computing environments. We've put together questions and answers for a better understanding of the latest mobos and their features.

Despite purchasing an overclockers kit with an XP2500 for an ABIT NF7-S, it will not overclock to 3200, as guaranteed. Both BIOS and Windows XP Pro SP1 report clock speed at 1100. Also, the IEEE and Ethernet device drivers do not load, although they are identified by XP Pro. Can this be fixed, or should the mobo be returned to the manufacturer?

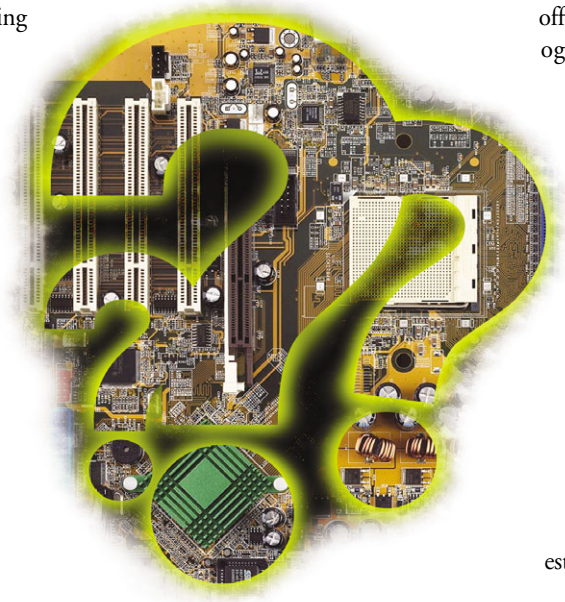
The best bet is to reset the CMOS and make sure the latest BIOS is installed before reinstalling the operating system. This board also has heat issues. A Vantec AeroFlow or other similar cooling system will reduce the heat issues that can also exacerbate mobo problems.

What are the latest Socket 940 mobos on the market?

MSI and ASUS both carry mobos with the Socket 940 platform.

MSI offers the K8D Master-FT and Master-F, both with a dual-Socket 940 for Opteron DP AMD 8131 chipset, and the K8T Master2-FAR with a dual-Socket 940 for Opteron DP/Athlon 64FX and VIA K8T00 chipsets. All three support Gigabit Ethernet.

ASUS has two models: the SK8N and the SK8V. In addition to Socket 940 support, both offer AMD64 architecture for simultaneous 32- and 64-bit computing.



As more performance is required out of server mobos, what models are emerging to fill this need?

Intel leads the pack with an assortment of mobos for server-class performance. With 10 different boards supporting the Xeon processor, two mobos for the Intel Pentium 4 processor, and three for the Intel Pentium III 512KB cache boards, Intel covers all the bases.

Tyan recently unveiled four Intel-based server-class platforms for the mid- to high-end mobo market. The Tyan Thunder i7520 and i7250R models provide a robust multiprocessor solution. With the Intel E7520 Lindenhurst enterprise server chipset, the i7520 and i7520R both support dual-Intel Xeon Nocona processors with EM64T (Extended Memory 64 Technology), multibus PCI-X expansion slots, two Gigabit Ethernet LAN ports, and up to 32/16GB of registered DDR266/333 memory. Both support Tyan's proprietary TARO SO-DIMM storage expansion module, which puts SATA or SCSI RAID capability on the board. The Thunder i7520 also features a PCI Express x8 slot, multiple PCI-X slots, and legacy PCI support, all for tower/pedestal configurations. The Thunder i7520R is the rackmount model with optimized air flow design.

MSI's newest server-class E7210 chipset, Master-FARM and the MasterX FA6R, offers the next generation of mobo technology. The MasterX-FA6R uses the Intel NetBurst microarchitecture and supports single/dual Xeon with 512KB L2 cache, and the Master-FARM supports a single Intel P4 processor with 533/800MHz FSB.

ASUS server-class mobos include the NCCH-DL and NCT-D for the Intel 875P chipset. Both support dual-Xeon (including the next-generation Nocona) architecture. The NCCH-DL delivers 800MHz FSB and 1MB L2 cache, as well as dual-channel DDR 400 support. The NCT-D boasts being the world's smallest dual-Nocona PCI-E mobo.

Longtime mobo manufacturer SuperMicro has highlighted its two products, the X6DH8-XG2 and the X6DA8-XG2. Both boards offer dual-Intel Xeon EM64T support up to 3.6GHz, up to 16GB DDRII-400 SDRAM, Intel 82546GB dual-port Gigabit Ethernet controllers, Adaptec AIC-7902 Dual Channel Ultra320 SCSI, two SATA ports via ICH5R SATA controller, and 0 channel RAID. The X6DH8-XG2 supports the Intel E7520 (Lindenhurst) chipset, while the X6DA8-XG2 is for the Intel E7525 (Tumwater) chipset. With more than 40 new models to choose from, SuperMicro has the mobo industry's most extensive line of mainboard technologies,

including PCI-Express, DDRII memory, and Intel's EM64T. Each mobo has been optimized for particular apps.

ABIT's SI-2Ns443 is an Intel Lindenhurst-VS-based motherboard with three Cavium CN-1120 IPSec/SSL controllers, up to 16GB memory, onboard ATI Rage XL, 8Gb LAN (up to four optical SFP), two SATA controllers, and USB 2.0. It also supports dual-Intel Xeon (Nocona) processors.

Delta Networks' server products support Socket 604 for Xenon and Socket 478 for Pentium 4. There are three models for Socket 604, two for Intel chipsets, and one for ServerWorks. For Socket 478, Delta has four mobos on its plate: three models for Intel chipsets and one for VIA. Its boards support Intel's one-way, two-way, and PIII/P4 and Xeon, in addition to supporting IDE RAID, SCSI, and IPMI.

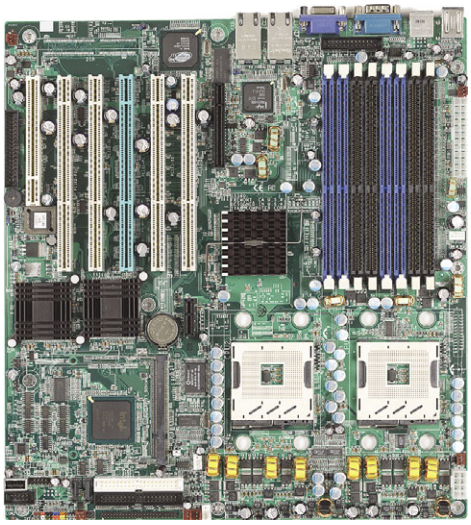
How do I get the best performance from the two Hitatchi SATA drives on my Athlon XP 3200+? Do I use RAID 0, 1, or 0+1? I've tried to set it up as RAID 0 thinking I would have one 80GB drive splitting the data transfer between two channels, but I only got a single 160GB drive.

RAID 0 combines the space of the drives, in your case 160GB total. RAID 1 is designed to mirror data in the event of a failure; thus, it would only be 80GB—double the access speed, so technically faster than RAID 0. RAID 0+1 requires four hard drives to implement and will offer the best performance. But keep in mind that RAID is designed for server applications and not the desktop.

What are the Platinum series mobos from MSI?

There are three Platinum series mobos offered by MSI, combining a rich feature set with quality performance. They come in Socket A and Socket 754 for AMD and Socket 939 for Athlon 64 and Intel Pentium 4 processors.

The K8N Neo2 Platinum is MSI's Socket 939 for AMD Athlon 64 FX-64 processor. It will also run the 3500+, 3800+, Athlon 64 FX-53, or higher CPUs.



The Tyan Thunder i7520 and i7250R models provide a robust multiprocessor solution.

The chipset is an NVIDIA nForce3 Ultra with a HyperTransport speed up to 1GHz. An independent pair of SATA controllers, along with dual Fast ATA-133 IDE controllers, can support up to four separate IDE devices.

When it comes to memory, the K8N Neo2 Platinum can handle dual-channel DDR 266/333/400, using four 184-pin DDR DIMMs and 2.5V DDR SDRAM DIMMs with memory size up to 4GB. Unfortunately, MSI is warning customers that the motherboards or system configurations can have performance issues using the BIOS defaults and suggests tweaking DDR voltage, memory speeds, and timing for system stability.

Similar to the K8N Neo2 Platinum, the K8N Neo Platinum is the Socket 754 version. The K8N Neo Platinum supports 64-bit AMD Athlon 64 processor 2800+, 3000+, 3200+, and 3400+ or higher. With only three slots for up to 2GB of 184-pin DDR SDRAM DIMMs, the Socket 754 model doesn't experience BIOS instability due to high-performance memory interference.

The K7N2 Delta2 Platinum supports Socket A for AMD Athlon, Athlon XP, Duron, and Sempron processors. Like the K8N series, the Delta2 offers comparable chipset, onboard IDE, SATA controllers, and slot configuration. However, when it comes to memory, the board supports up to six memory banks of three 2.5V 184-pin DDR DIMMs, both 64-bit and 128-bit DDR SDRAM up to a maximum of 3GB.

How do mobo manufacturers name their products?

Individual manufacturers have specific ways of naming their products. For example, AOpen bases its product names on a three-part convention. The first character, either an A or an M, is the form factor—either ATX or micro-ATX. The second set of characters represents the CPU. AOpen boards support seven different processors, and each one has its own code, such as X4 for an Intel Pentium 4 or K8 for an AMD Athlon 64. The final set of characters represents the chipset and extension model such as 9D-400 for an NVIDIA nForce Ultra 400. So if the mobo is a micro-ATX with a Pentium 4 using the NVIDIA nForce Ultra 400, it would be named the MX49D-400.

Other manufacturers follow similar naming conventions, even using similar codes. At MSI, the chipsets are similarly determined by using K7 and K8 for AMD Athlon XP and 64, respectively. MSI's series names are different, though, using names such as Neo, Master, and Platinum to signify whether the board was designed for a high-end desktop, workstation, or special edition. Mobo features are denoted by characters, such as F for Gigabit LAN or 2R for IDE RAID + SATA RAID.

Gigabyte's naming conventions go a step further because it changes the names of its products. Take the GA-7DPXDW-P, which used to be called the GA-7DPXDW+. Yes, you guessed it. The P stands for plus.

AOpen recently introduced its i865PEa/i865Ga/i800P series. What can these mobos do?

AOpen's goal was to give customers tailored options. With the introduction of its Pentium 4 Socket T motherboards (ATX) sporting three different chipsets (Intel 865PE, 865G, and 848P), AOpen offers 800MHz FSB, AGP 8X graphics, dual-channel DDR 400/333 memory, and

Hyper-Threading across the boards. The i865Ga has the added support of ADD2. All three series have Intel PHY LAN capabilities and the i865PEa and i865Ga also support Gigabit LAN. Only the i865PEa supports RAID 0/1 for a striping or mirroring array using two SATA hard drives.

I get returned to Windows during games when using my 3D card for an extended period. I'm running an NVIDIA GeForce 3 (AGP 4X) card with an A7N8X-E board (nForce2, AGP 8X) with the latest drivers for both devices. What is causing this, and how can it be resolved?

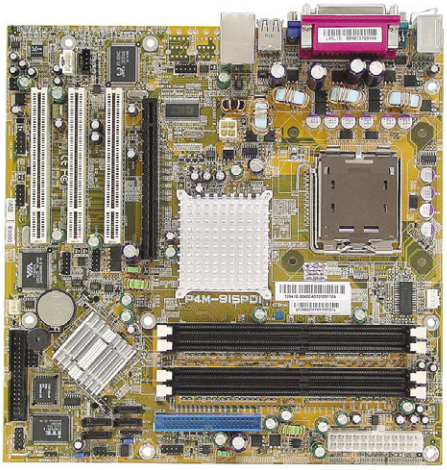
It sounds like the card is overheating. Try installing a case exhaust fan to better cool the inside of the case. And another thing: While the device drivers may be up-to-date, the BIOS should also be running the latest version. If those first two suggestions don't solve the problem, then check the RAM. You can check the memory by running the memory diagnostics available at oca.microsoft.com/en/windiag.asp.

What about SFF mobos?

Taking the market by storm, SFF machines have been dominated by Shuttle. What started as a way to provide all the capabilities of a PC in a home theater system has been the first salvo in the march forward toward a digitized home life. Unfortunately, the SFF mobos lacked performance because their aim was not to replace the larger PC.

But thanks to advancements in chipsets, cooling, power, and design, SFFs are delivering comparable performance to a desktop or laptop PC. Intel's 865G+ and ICH5R chipsets brought performance to the SFF space. Just as with today's high-end mobos, the SFF systems support Hyper-Threading, dual-channel DDR400, 800MHz FSB CPUs, USB 2.0, AC'97 audio, SATA, and integrated graphics. Unfortunately, that type of performance doesn't come without a price.

The primary issues of heat and cooling are directly tied to power requirements. Whether the processors are from Intel or AMD, they all create huge amounts of heat as more features are stuffed into a tinier package. Heat dissipation has now become a major concern for SFFs, as well as CPU manufacturers. These issues are being addressed through efficiency and design.



Aimed at both consumer and enterprise users, the FIC P4M-915GD2 is based on the new Intel 915G Express chipset and features Intel GMA 900.

The Biostar IDEQ 200T, EPOX eX5-320S, and FIC Condor are all SFFs based on Intel's 865G chipset. The Biostar IDEQ 200T supports Intel's Pentium 4 800MHz frontside bus with Hyper-Threading. Memory capabilities include two DDR400 slots using dual-channel memory architecture providing for up to 2GB in total system memory. The expansion slots are limited to one PCI and one AGP 8X, but the board can accommodate as many as two EIDE devices using Ultra DMA 33/66/100 Bus Master Mode.

EPOX, which has been around only 10 years (a relatively short time compared to most other mobo manufacturers), tenders an SFF mobo, the EP-4PGF+, which is based on Socket 478 with two DIMM slots for dual-channel DDR 400, one PCI slot, and one AGP 8X slot, similar to Biostar's board.

FIC's Condor board, also like the mobos from EPOX and Biostar, are based on Socket 478 Intel Pentium 4 processors with a 400/533/800MHz frontside bus. A little bigger in size, the Condor has two PCI slots instead of one, but other than that, it pretty much offers the same features and performance.

Who is doing dual Opteron?

Once AMD finally released the Opteron processor, the server market snapped up the 64-bit platform right away, but for everyday working folks, the availability of the dual Opteron mobos with AGP slots was sparse. Contrary to the propaganda from the tech industry in regards to the AMD64, few mobo manufacturers have chosen to offer dual-Opteron boards.

The K8T Master2 from MSI supports VIA K8T800 northbridge and VIA VT8237 southbridge with interconnect for a 16-bit, 800MHz HyperTransport on the processor and a 16-bit, 533MHz V-Link for the chipset. For memory, the board can handle four 184-pin DIMM sockets for a maximum of 8GB of DDR-200/266/333/400 SDRAM with ECC.

Tyan offers two boards that handle dual Opterons: the Thunder K8W and the Tiger K8W. A beefier board than the Tiger, the Thunder offers AMD-8131 PCI-X tunnel in addition to the Tiger's AMD-8151 AGP tunnel and AMD-8111 I/O Hub chipset support. Both have five expansion slots, but the Tiger has a straight 32-bit/33MHz, while the Thunder offers one 32-bit/33MHz, two PCI-X 64-bit/100MHz, and two PCI-X 64-bit/133MHz slots.

All three models have four 184-pin DIMM sockets for a maximum of 8GB of registered DDR200/266/333/400 SD-RAM with ECC and come with Gigabit Ethernet. Tyan adds a nice touch to make memory installation easy; the DIMM slots are color-coded in two-slot pairs. Because Opterons have dual-channel memory controllers, DIMMs should be added in pairs for optimal performance.

What mobos are being used in embedded environments such as NAS systems and Web appliances?

American Megatrends Indium unites the company's experience in board technology with OS environments for securely integrated appliances such as a Web server or NAS. Designed to meet the OEM market

need for server appliances, Indium supports a single socket 370 Celeron/Pentium III up to 733MHz with Intel's 810E chipset. A single DIMM provides up to 256MB 100MHz SDRAM. There is dual onboard 10/100Mb LAN, USB, and Ultra2 LVD SCSI support.

For embedded applications such as gaming devices, point-of-sale thin clients, and kiosks, Advantech's AIMB-340 is a good option. The AIMB-340 is based on Intel's embedded ATX form factor, which is a low-profile specification for embedded mobos providing the leading-edge processor technologies in an affordable package.

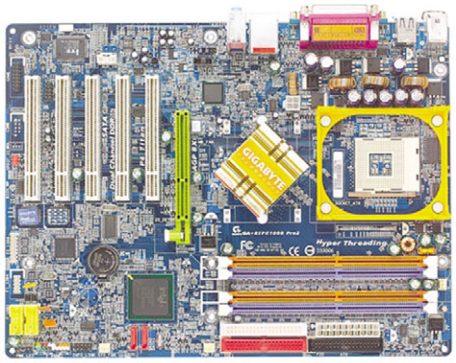
For industrial environments, COMMELL offers a full line of all-in-one compact socket 478 Pentium 4/Celeron mobos based on the 845G ICH4 chipset. Despite a miniflex form factor of 170 x 170mm, COMELL's boards can still deliver up to 1GB DDR200/266 SDRAM.

As bandwidth-intensive applications continue to grow at an exponential rate, are there new mobos hitting the market for handling fat pipe computing?

Yes. FIC recently introduced two micro-ATX form-factor boards specifically designed to handle high-bandwidth computing. Aimed at both consumer and enterprise users, the P4M-915GD1 and P4M-915GD2 motherboards are based on the new Intel 915G Express chipset and feature Intel GMA 900 (Graphics Media Accelerator 900), which utilizes a ground-breaking graphics core and redesigned 3D engine capable of delivering up to twice the graphics performance of earlier Intel platforms.

The P4M-915GD1 mobo offers 800MHz FSB support and optimized performance using Pentium 4 processors with Hyper-Threading. The board is outfitted with four dual-channel DDR 400/333s, offering up to 4GB; one PCI-E x16; three PCI; four SATA supporting RAID 0, 1; embedded Realtek 10/100/ 1000 LAN; eight-channel Audio Codec & Intel High Definition Audio; two FireWire ports; and eight USB 2.0 ports.

FIC's second model, the P4M-915GD2, similar to the P4M-915GD1, ramps up on memory with four dual-channel DDR2 533/400s supporting up to 4GB. Slots include one PCI-E x16, one PCI-E x1, two PCI, and four SATA supporting RAID 0, 1. The 10/100/1000 LAN is embedded.



The P4 Titan GT-Wireless edition from Gigabyte Technology is bundled with an 802.11b GN-WBZB0M USB wireless LAN card for high-speed networking of up to 11Mbps.

With AMD's recent release of the Sempron processor, which mobos are able to support it?

Get ready to be confused. Semprons from 2800+ and down work with Socket A platforms and are basically Athlons with 256KB of cache. However, the 3100+ and up are entirely new processors for Socket 754 and eventually Socket 939. This means users will be able to upgrade from 32 bit to 64 bit while keeping the same hardware.

Leveraging existing motherboards has made Sempron's adoption even easier. All of Gigabyte's RZ series AMD motherboards will support the Sempron 2800+ and below, while the 3100+ processors will work in all of Gigabyte's Socket 754 mobos. ASUS lists five models for the 3100+ and 15 boards for the 2800+ and below Semprons.

Have mobo manufacturers begun integrating Wi-Fi features into their products?

Yes. The growing demand for 802.x functionality has led to mobo manufacturers integrating wireless networking right on their boards.

ASUS offers an assortment of solutions for Wi-Fi. Its PAD2 and PAG2 series all have onboard 54Mbps 802.11g wireless functionality. The A8V Deluxe comes bundled with a 54Mbps Wi-Fi-g PCI card. Fourteen ASUS mobo models also sport a Wi-Fi slot designed for ASUS' wireless LAN add-on card, the ASUS Wi-Fi-b. The slot supports the 802.11g standard. Additionally, ASUS also offers five wireless-edition motherboards: P4C800 and P4P800 Deluxe Wireless, P4P800 Wireless, P4P800S-E Deluxe Wireless, and K8V Deluxe Wireless.

The P4 Titan GT-Wireless edition from Gigabyte is bundled with an 802.11b GN-WBZB0M USB wireless LAN card for high-speed networking of up to 11Mbps.

The capacitors on my SOYO Dragon 2 are so close to the CPU that I can't use my Vornado HSF. This is a brand-new heatsink; is there any way I can use it?

Yes, but it will take some modifications. For heatsinks that are too close to capacitors, they can be shaved to fit using a grinder or Dremel tool.

An IDE RAID controller is one of the best ways to ensure data integrity and security. Are they being integrated onboard?

Yes. As the controllers become less expensive, numerous vendors are building them into their boards, mostly SATA. SATA adds significant technical advancements over traditional ATA making it ideal for onboard RAID implementations. SATA technology advances data transmission through a point-to-point topology, which removes bus sharing, thereby delivering a full 1.5Gbps bandwidth to each drive.

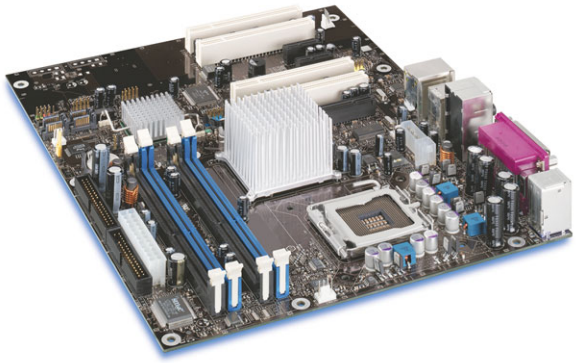
ASUS leads the pack. Its mobos with onboard SATA RAID are the K8V-X Socket 939, K8V-X Socket 754, P5GD2 Premium Wireless Edition Socket T, SAD2-P/W Socket T, SK84 Socket 940, P5GD1 Socket T, A7V600 Socket A, A7V600-X Socket A, P4P800E Deluxe Socket 478, A7N8X-E Deluxe Socket A, SK8N Socket 940, K8N-E Deluxe Socket 754, and K8V SE Deluxe Socket 754.

Abit is next in line with 11 models with onboard RAID: AV8, KV8, KV8 Pro, AA8 Max Socket T, AG8 Socket T, AS8 Socket T, DV7 Socket A, AN-7 Socket A, IS7 Socket 478, IC7-G Max Advance

Socket 478, and the NF7-S Socket A.

MSI follows closely with eight boards supporting onboard RAID: K8T Master-2 FAR Socket 940, K8T Neo2-FIR Socket 939, 915P-Neo2 Platinum Socket T, 915-Combo FR Socket T, PT880 Neo LSR Socket 478, K8T Neo FSR, K87 NeoF IS2R Socket 754, and the KT6V-LSR KT600.

Intel only lists four mobos with onboard SATA RAID: the server board SE7505VB2, the desktop board D925XCVLK, the D865PERLL Socket 478, and the desktop board D865PERL.



Intel's D925XCVLK desktop board includes onboard SATA RAID.

As Gigabit Ethernet becomes more popular, will it be included in more mobos?

Gigabit Ethernet, also called 1000Base-T Ethernet, increases traditional 100Base-T Ethernet speeds tenfold. Many server-class motherboards support Gigabit LAN, and the trend is trickling down into desktop and workstation boards.

For example, MSI's K8T Neo2-F socket 939 ATX motherboard ships with a Realtek 8110S Dual layout, which includes an onboard Gigabit Ethernet MAC and PHY transceiver with IEEE 802.3 auto-negotiation. In addition to 1000Base-T, 10/100 single port LAN is also supported. The native LAN support is compliant with PCIv2.2 and the LOM (LAN on Motherboard) standard.

Another popular vendor for onboard networking is Broadcom, with its 10/100/1000Base-T controller with integrated transceiver. More than just a simple on-board network solution, Broadcom's PCI v2.2 LOM offers advanced features such as VLAN, priority queuing, and jumbo frames. RISC processors are also supported. Shuttle has replaced the native Gigabit Ethernet on its AN51R boards with Broadcom's Gigabit Ethernet.

Over the years, features such as audio, video, and networking have all gone from added features to being baked right onto the board. What's next?

Security. NVIDIA broke ground when it included a native firewall on its nForce3 250Gb chipset. It works similarly to a broadband router or independent hardware-based firewall, where you administer the device through a command-line interface. Not just based on NAT, this firewall supports both stateful and stateless inspection. A major advantage of the onboard firewall is it becomes active as soon as the driver is loaded on bootup, protecting the TCP connection as soon as it becomes active. Processing power is also reduced compared to software-based firewalls.

NVIDIA's nForce3 250GB is optimized for the AMD Athlon 64, Athlon 64 FX, and AMD Opteron 64-bit processor families.

What is dual-channel DDR, and how does it work?

Until Intel launched its new motherboard architecture in 2003, single-channel memory was the only option. When processor requirements began to exceed memory speed, a second channel was added to the memory layout to mitigate the issues of possible computing bottlenecks.

The important thing to remember is that even if the board supports dual-channel DDR, that doesn't necessarily mean that both channels are being utilized because the board can be configured for either single-channel or dual-channel mode. For dual-channel DDR (128-bit) high performance, at least two or more DIMM modules must be installed in the proper slots-the A channel and the B channel. The memory must also be identical, meaning you can't have 256MB in channel A and 512MB in channel B. They must also be the same speed.

When fitting the Vantec Iceburg 4 on a 9800Pro, the center of the heatsink is flush with the shim around the CPU, so it is barely touching the CPU. Will putting on a little more AS5 (Arctic Silver) compensate?

Too much AS5 will actually cause more heat because it will take longer to dissipate the heat. There are two solutions: one, remove the wad of AS5 and add a thinner layer, or two, put another or the old heatsink back until you resolve the issue.

AMD released the Socket 939 platform this year. What are the features and advantages of this new platform?

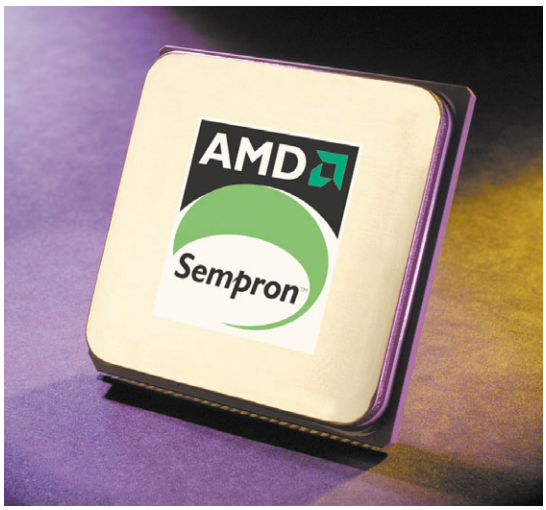
Billed with the potential for becoming a long-life stable platform for high-performance computers, AMD designed the Socket 939 platform to support its new line of Athlon 64 processors with dual-channel memory. Mobo manufacturers such as Abit, ASUS, Shuttle, MSI, and GIGABYTE have launched Socket 939 boards.

Compared to AMD's Socket 940, there are a few key differences. First, AMD ditched the ceramic packaging in favor of organic packaging. By switching to organic substrates—usually resin or fiberglass—to house the processor core, impedance and production costs are reduced while the durability increases. You can easily tell the difference by the color. Ceramic packaging, such as with older Athlon/Duron models, is a blue-gray, unlike the brown or green of organic packaging.

Faster HyperTransport links at 2GHz DDR with up to 8GBps of total bandwidth is another plus for Socket 939. It should be noted that because it only has a single HyperTransport link, Socket 939 does not support multiprocessors.

But the best feature is that Socket 939 no longer requires registered memory, which means standard, unbuffered DIMMs will work just fine.

From the looks of it, AMD plans to use the Socket 939 platform to mainstream its AMD Athlon 64 3000+. More advantages abound from this plan. Because the core only has half of the L2 cache of previous generations but retains the same 128-bit memory controller, that means the core is much smaller and less expensive to manufacture. Even better, just because there is less L2 cache, there isn't a significant performance hit.



Leveraging existing motherboards has made adoption of AMD's Sempron processors easier.

What does the future hold in regards to dual-core processing?

Both AMD and Intel are pushing toward dual-core processing. Dual-core AMD Opteron and Intel Xeon processors are scheduled to be available in mid-2005. The release of this technology is expected to allow multithreaded operating systems such as Linux, Solaris, and Windows to more efficiently handle the simultaneous administration of single-threaded applications common in notebook and desktop computing environments.

The duality comes through Hyper-Threading, which lets applications treat individual processors as a two virtual ones. The idea is to increase processing power while reducing electrical power, which generates heat.

Another added bonus is that users will be able to upgrade their existing systems that are compatible with the 90nm single-core to dual-core processors.

What is all the rage about PCI Express?

Since the introduction of the PCI bus in the early 1990s, little has changed in comparison to the exponential advancements in other technologies such as processors, memory, I/O, video, and audio cards. Even today, most peripherals, hard drives, NICs, and USB drives use the same I/O as, say, a 486 PC. The PCI bus still operates at 33MHz, moving data at a rate of 133MBps. To get around the limitations of the PCI bus, technologies such as the Pentium 4 use DDR memory to transfer data across the memory bus at a rate of up to 2.1GBps. With the advent of new technologies such as Gigabit Ethernet, RAID, and SCSI, moving data at standard PCI bus rates is a limiting factor.

Some advancement has been made in PCI technology with specifications designed to meet bandwidth expectations-the 66MHz PCI; PCI-X, which offers 64-bit/133MHz; and the new PCI-X 2.0. The problem with these advanced PCI technologies, such as the controllers required for individual slots for the PCI-X 2.0, is that these advancements are cost-prohibitive for anything but the high-end server mobo market.

Intel is hoping to come to the rescue with its new standard for I/O—PCI Express—which is designed as an upgrade and not a replacement for the existing PCI bus. Approved as a standard in 2002, PCI Express was only released on new mobos this year. It is forecasted to offer enough scalability to last for another decade.

PCI Express has several formats: x1, x2, x4, x8, x12, and x16. To better understand these designations, look at it this way: Each lane is composed of 4 pins-x1 has one lane, x2 has two lanes, x4 has four lanes, and so forth. Each pin has the ability to transmit 100MBps.

The format of the slots themselves is radically different from traditional PCI. Being attached to a switch controlling data flow offers an advantage over a shared bus because individual devices have direct access to the bus instead of having to share. This offers complete bandwidth to each slot instead of each PCI device having to compete for the maximum allowed by the shared bus. Think of it as having your own private lane on a freeway instead of having to share a single-lane road.

Engineers are already looking at x32 and x64 slots for applications such as high-end graphics and sound cards. For now, look for x1, x2, and x16 slots to first appear on new mobos.

ASUS, ASRock, and GIGABYTE have begun integrating PCI Express into their production using both Intel and AMD platforms.

Is Intel really going to release its next-generation BIOS code under an open-source license?

The foundation code for Intel's EFI (Extensible Firmware Interface) BIOS will be released as part of an open-source license. This next-generation BIOS has an OS-agnostic preboot environment that will let mobo manufacturers create their own onboard applications such as security features and diagnostic tools.

Intel is also providing a firmware driver development kit for developers, which the company released along with the core foundation code. Additionally, Intel has used EFI to produce a preboot software framework, called Platform Innovation Framework, that lets manufacturers create preboot modules that will allow the hardware to become operational before handing over control to the operating system. This means computers will ultimately be able to boot faster, be more secure, be managed remotely, and have the ability to run diagnostic utilities such as antivirus scans before loading the operating system. CPU

by Sandra Kay Miller

Manufacturers & Products Index

3dfx
Voodoo2, 206

A

A-Top
Z-Alien, 185
Abit
AA8 Max Socket T, 220
AA8-DuraMAX, 130
AG8 Socket T, 220
AN-7 Socket A, 220
AS8 Socket T, 220
AV8, 220
AV8-3rd Eye, 121-122, 123, 126
DV7 Socket A, 220
IC7-G Max Advance Socket, 478, 220
IS7 Socket 478, 220
KV8, 220
KV8-MAX3, 138
KV8 Pro, 220
NF7-M, 198
NF7-S Socket A, 221
NF7-S, 64-66
SI-2Ns443, 218
VT7, 31-333
Advantech
AIMB-340, 220
AMD
Dual Opteron, 112-117
Processors (Refer to Mobo Reviews section pp. 64-111)
Socket 754, 91-93
Antec
Performance Plus1080AMG, 188
AOpen
AK89 Max, 79-81, 82-84
i800P, 218
i865Ga, 218
i865PEa, 218
i915Ga-E, 8-9
i915Ga-EFRII, 9
i915Gm-I, 8-9
i915Pa-E, 8-9
i915Pa-EFII, 9
nCK804a-LFS, 9
nCK804Ua-LFS, 9
Aspire
X-Dreamer II, 186
ASUS
A7N8X-E Deluxe Socket A, 220
A7V600 Socket A, 220
A7V600-X Socket A, 220
A7V880, 67-69
A8N-E Deluxe, 9
A8V Deluxe, 122-123, 126, 220
K8N-E Deluxe Socket 754, 220
K8V Deluxe Wireless, 220
K8V SE Deluxe Socket 754, 220
K8V-X Socket 754, 220
K8V-X Socket 939, 220
NCCH-DL, 217
NCT-D, 217
P4C800, 220
P4P800 Deluxe Wireless, 220
P4P800 Wireless, 220
P4P800E Deluxe Socket 478, 220
P4P800S-E Deluxe Wireless, 220
P4R800-V Deluxe, 139
P4S800D-E motherboard, 37-39
P5AD2, 8
P5AD2 Premium, 8, 131
P5GD1 Socket T, 220
P5GD2 Deluxe, 61-63
P5GD2 Premium Wireless Edition Socket T, 220
PAD2 and PAG2 series, 220
PFGD2, 8
SAD2-P/W Socket T, 220
SK84 Socket 940, 220
SK8N, 94-96
SK8N Socket 940, 217
SK8V, 97-99, 217
ATI
Radeon X series GPU, 202-203
Radeon X800 XT Platinum Edition, 5
Rage Fury Maxx, 206-207
RS-480, 7
RX480, 7
ATX
Mid Tower, 196
Socket 939 NVIDIA nForce3 Ultra, 109-111

B

Back-up
Q EasyGo USB 2.0 to IDE Adapter Cable, 214
BenQ
DW1620, 163
Biostar
IDEQ 200T, 219
IDEQ 200T, 219

C

Chaintech
9CJS Zenith, 49-51
V915P, 8
V925X Zenith VE, 8
Z925X Zenith, 8
NVIDIA GeForce FX5900XT, 200
S865PE, 46
Chenming
601 Aluminum Silver, 189
Cooler Master
Ceturion 5 CAC-T05, 184
Real Power 450W, 176
Cooltechnica
AquaXtreme XG, 195

D

DangerDen
Black Ice Xtreme radiator, 194
Hydor L30 pump, 194
Maze4 waterblock, 194
Typhoon Quad reservoir, 194
D-Link
D-Link 7-Port USB Hub, 216
D-Link Air 2.4GHz Wireless USB Ethernet Adapter, 215
DFI
LANParty 925X T2, 128
NFII Ultra Infinity, 70-72

E

ECS
755-A2, 76-78
KV2 Extreme, 123-124, 126
Enermax
CS-5190AL, 190
EPoX
8KDA3+ motherboard, 85-87
8KDA3+, 18-19
EP-4PGF+, 219
EP-4PGF+, 219
ex5-320S, 219
ex5-320S, 219

F

FIC
Condor, 219
P4M-915GD1, 220
P4M-915GD2, 220
Foxconn
915A01-8EKRS, 8
915A01-8EKRS2, 8
925A01-8EKRS, 127
925A01-8EKRS2, 8
FSP Group
AX500-A, 176
FrozenCPU
Chenming 901, 193

G

Gainward
NVIDIA GeForce FX5700LE, 200
GelL
512MB PC2-5300 DDR2, 205
GIGABYTE
8KNXP, 140
GA-8ANXP-D, 9, 130
GA-8GPNXP Duo, 9
GA-8I915G Pro, 52-54
GA-8IG1000 Pro-G, 40-42
GA-K8NNXP-940, 100-102
GA-K8NSNXP-939, 106-108
KZ Series, 220
P4 Titan GT-Wireless, 220

H

HighPoint
RocketHead 100 Serial ATA Converter, 212, 213
Hitachi
GST Deskstar 7K250 EIDE 164.7GB, 152
GST Deskstar 7K250 SATA 82.3GB, 157
GST Deskstar 7K400 SATA 400GB, 154
G ST Travelstar 5K100 EIDE 80GB, 154
GST Ultrastar 15K73Ultra320 SCSI 73.9GB, 159

I

Intel
865PE chipset, 46
875P, 49-51
9151 chipset, 204
915G chipset, 52-54, 55-57
915P chipset, 52, 58, 61, 63
925X Chipset, 127
Celeron D 335, 50-51
D865PERL, 221
D865PERLL Socket 478, 221
D915PCYL, 58-60
D925XCVLK, 127, 221
I865G, 40-42
Matrix RAID, 160-162
Processors (refer to Mobo Reviews section pp. 31-63)
RL865-10A, 140
SE7505VB2, 221

K

Koolance
PC2-601BW, 192

L

Lite-On
SOHC-5232K, 167

M

Maxtor
Atlas 15K Ultra320 SCSI 73GB, 158
DiamondMax 10 SATA 250GB, 155
DiamondMax Plus 9 EIDE 200GB, 153
MaxLine II Quick View EIDE 300GB, 151
MSI
915-Combo FR Socket T, 221
915G Combo-FR, 55-57
915P-Neo2 Platinum Socket T, 221
925X Neo Platinum-54g, 9
K7N2 Delta2 Platinum, 218
K87 NeoF IS2R Socket 754, 221
K8D Master-F, 217
K8D Master-FT, 217
K8N Neo Platinum, 218
K8N Neo2 Platinum, 109, 111, 218
K8T Master-2 FAR Socket 940, 103-105, 115-117, 221
K8T Neo FSR, 221
K8T Neo2-FIR Socket 939, 221
K8T NEO2-FIR, 123, 124-125, 126
K8T Neo-FIS2R, 88-90
K8T Neo-FSR, 88
K8T-Neo2 Platinum Socket T, 221
KT6V-LSR KT600, 221
MasterX-FA6R, 217
MS-6728, 141
PT880 Neo LSR Socket 478, 221
SLI K8N, 6

N

NEC
ND-3500A, 164
NVIDIA
GeForce 256, 206
GeForce 4 MX, 198
GeForce 6 series GPU, 202-03
GeForce 6800 Ultra, 5, 7
MCP-T, 64, 65
nForce Pro-150, 94-95
nForce Ultra 400, 220
nForce2 Ultra 400, 64, 70
nForce3 150, 80-81, 82-24, 100
nForce3 250 GB chipset, 85, 87, 220
nForce3 250, 91-93
nForce3 Ultra, 106-108
nForce4, 7, 9

O

Optorite
CW5201 52X/32X/52X CD RW, 166

P

Pioneer
DVR-108BK, 164
Plextor
PX-712SA, 165
Premium 52X/32X/52X, 166

Q

Qniq
MITX-845GVD, 135

R

Raidmax
Scorpio 668W, 183
Rosewill
NVIDIA GeForce MX4000, 199-200

S

Samsung
SM-352B, 167
SpinPoint SP0812C SATA 80GB, 157
SpinPoint SP1614N EIDE 160GB, 153
Sapphire
ATI Radeon 7000, 199-200
ATI Radeon 9200SE, 200
ATI Radeon 9600SE, 200
ATI Radeon 9600XT, 199-200
Seagate
Barracuda 7200.7 EIDE 160GB, 152
Barracuda 7200.7, 156
Cheetah 15K.3 Ultra320 SCSI 18.4GB, 159
Savvion Ultra320 SCSI 73.4GB, 158
Shuttle
AN51R, 221
SIIG
USB2.0, FireWire, SATA Combo PCI card, 216
SilverStone
SST-ST30NF, 177
Temjin TJ04, 191
SiS
655TX chipset, 37-39
755 northbridge, 76-77
964 southbridge, 76-77
Soltek
SL-K8AN2E-GR, 91-93
SL-K8TPro-939, 123, 125 126
Sony
DRU-700A, 165
DRU-710A, 163
SOYO
SY-P4VTP motherboard, 34, 36
SY-KT600 Dragon Ultra Platinum, 73-75
SY-P4VTP, 31
Super-Micro
X6DA8-XG2, 217
X6DH8-XG2, 217

T

Thermaltake
Silent PurePower TWV480, 177
Xaser III Super Tower V1420DU, 182
Tyan
S1833D Tiger 100, 223
Thunder i7250R, 217
Thunder i7520, 217
Thunder K8W, 219
Tiger K8W S2875, 112-114
Tiger K8W, 219

U

Ultra
X-Connect 500W ATX, 178
Universal
Universal Molex Pin Extractor, 214, 215

V

Vantec
ION 2 350W, 178
VIA
EPIA MII12000, 134
EPIA PD10000, 134
EPIA TC10000, 136
EPIA MII6000E, 135
K8T800 Pro, 97-98, 103-104
K8T800/8237 chipset, 85
KT600, 73, 75
KT880, 67, 68
PT800, 31
PT880 chipset, 31-32, 34-36
VT8237, 67-68, 73, 97-98, 103-104
VioMax
VioMax IDE Hard Drive to Serial ATA 150MHz Converter, 214

W

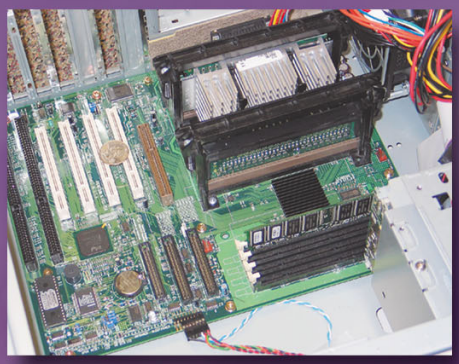
Western Digital
Caviar Special Edition EIDE 120GB, 151
Raptor WD740GD, 156
WD2500SD RAID Edition SATA 250GB, 155

Z

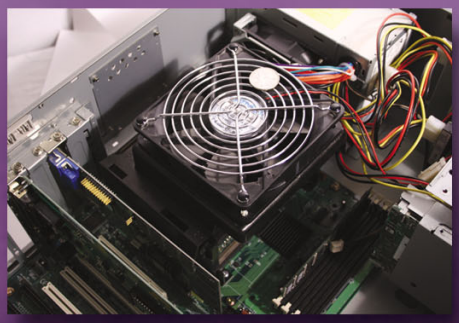
Zalman
TNN 500A, 197

Whose Board Is It, Anyway?

Our Biggest Fan



Slotted processors we can deal with. It's that other little circuit card that's wigging us out.



The last time we saw a fan like that, it had a dorm room attached to it.

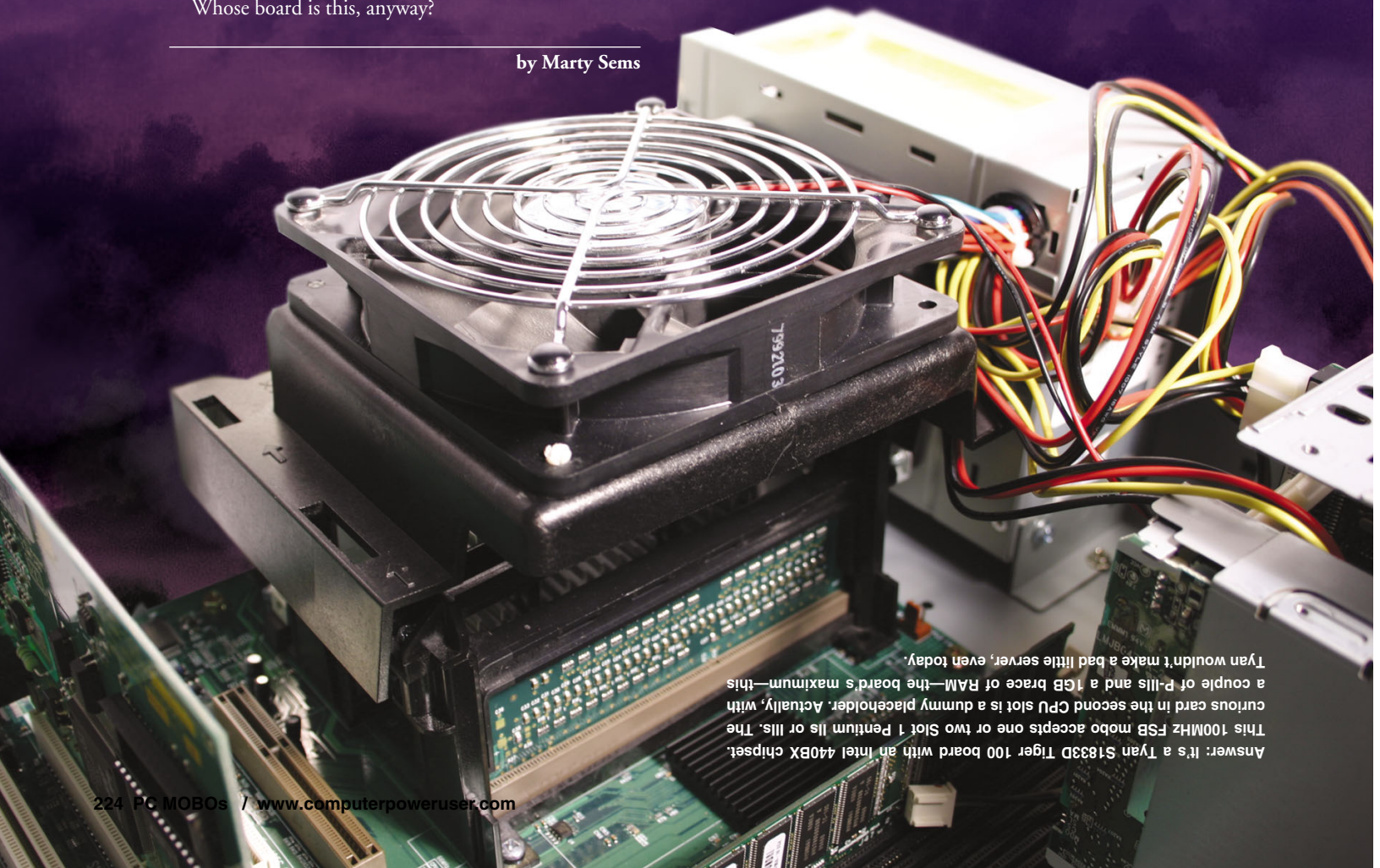
"That's one big, honkin' fan." Those words just spilled out of us when we cracked the side panel on this state auction refugee. Any CPU fan that requires a structure like a bridge truss to keep it from crashing down onto the motherboard gets our respect.

Underneath that monstrous blower, the curiosities continue. The Slot 1 Pentium II we recognize, but what's the weird card in the similar slot nearby? Supplemental static RAM? An L3 cache? A cheese grater?

Apart from these oddities, this mainboard looks like a typical, full-sized example from the ATX form factor's early days. It apparently accepts AGP graphics cards and 168-pin SDRAM, yet it also makes room for not one but two ISA (Industry Standard Architecture) expansion cards. In case those features don't provide enough scale for you, we dropped a quarter on the PCI slots.

Whose board is this, anyway?

by Marty Sems



Answer: It's a Tyan S1833D Tiger 100 board with an Intel 440BX chipset. This 100MHz FSB mobo accepts one or two Slot 1 Pentium IIs or IIIs. The curious card in the second CPU slot is a dummy placeholder. Actually, with a couple of P-IIIs and a 1GB brace of RAM—the board's maximum—this Tyan wouldn't make a bad little server, even today.

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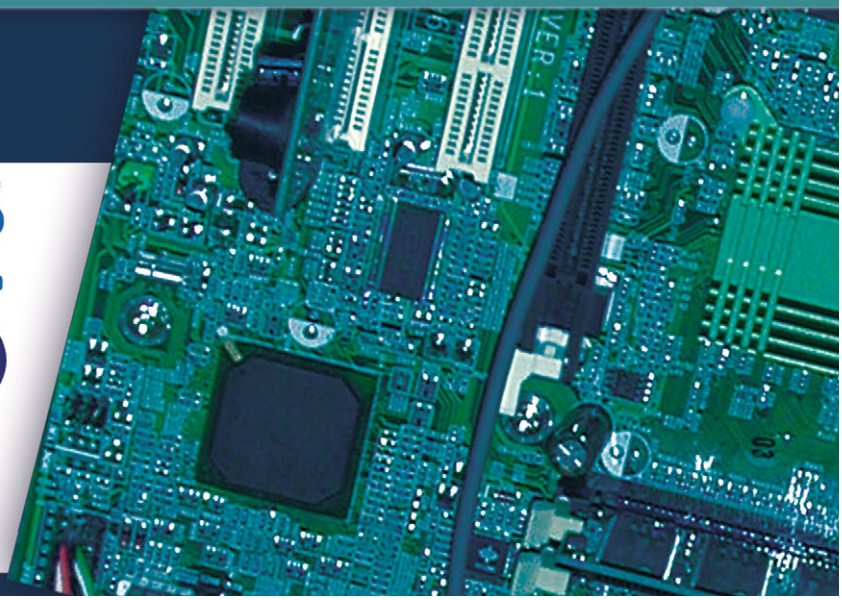
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